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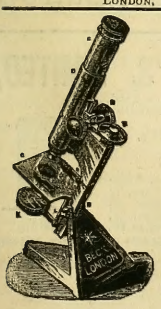

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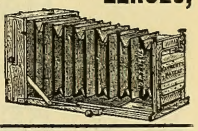

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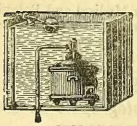

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INTRODUCTION.

SCIENTIFIC NEWS was established nearly a year ago as a monthly publication in order to bring subjects of scientific interest within the reach of general readers. Its increasing circulation has proved that the need for such a paper existed and has entirely falsified the predictions of certain sceptics who contended that however good such a journal might be it would find no readers. Our view was that a very large number of persons have a decided taste for and a general knowledge of science, though they may not have enjoyed sufficient technical training to enable them to understand and appreciate journals which address themselves to experts, specialists and professional readers. Moreover, the elements of several branches of science are now taught in many of our public schools; there are science schools in most of our large towns, and in addition serious efforts are now being made to effect the spread of technical education.

Therefore, without going further a-field, we concluded that our sceptical advisers were mistaken in their estimate, and that readers would be found, if suitable matter were provided. The task we set ourselves was not easy, and we freely admit that we have not always succeeded in fully carrying out our plans, but we hope that our ten months' experience has enabled us to gauge more accurately the nature of the subjects suitable for the general reader, and the best method of treatment.

Of late we have been urgently advised to publish weekly, because in these days of rapid thought and hard work, so much takes place in a month that the connecting links between monthly numbers are often lost or forgotten. We have at last yielded to this advice, believing after mature reflection that by so doing we shall best serve the interests of our readers and ourselves.

At the same time we have taken the opportunity of introducing some novel features, both in the scope and the arrangement of the journal, which will, we trust, be welcome.

We are not concerned with abstract science, which can only be properly dealt with in papers which address themselves to specialists, nor do we profess to treat professionally such subjects as chemistry, physics, engineering, etc. On the other hand, we do not presume to think that because our readers have not received a technical education, their intelligence is in any way inferior to that of their technically-trained brethren. What we wish therefore to do, is to play the part of collector and interpreter, and to explain to our readers in plain and untechnical language the important results of modern scientific research.

CURRENT EVENTS.

SIR JOHN LUBBOCK ON ETHNOLOGY.—Sir J. Lubbock's recent lecture in the Royal Victoria Hall contains many views of great importance to the British people. The speaker referred to many and serious blunders committed in the attempt to force our moral code and our civilisation upon savages who are totally unprepared for such a sudden change. "We are very apt to forget that throughout the far-stretching British Empire morals are very much a question of latitude and longitude." Sir John gave many amusing instances of savage ideas and misconceptions. He mentioned that among African negroes the doctor called in to a patient in some cases took the medicine himself—"a custom not conducive to a large

practice." Many savages cannot comprehend natural death, but suppose that the deceased has in every case been killed by witchcraft or by an evil spirit.

THE ROYAL SOCIETY.—It can scarcely be said that this year the address of the President (Professor Stokes) is worthy either of the occasion, or of his own merit. In noticing the losses which the society has suffered by death during the year, he introduced a defence of the strange statute "which enables the Council to recommend to the society for election in addition to the fifteen who are selected in the ordinary way, and nearly always on account of their scientific claims, persons who are members of Her Majesty's Privy Council, and *whose ability is thus attested (?), though they are not usually men of science.*" The speaker might have said "though they are often indifferent or even hostile to science." A foreign contemporary remarked some years ago that, "whichever party was in power, the English Government was always unfavourable to science."

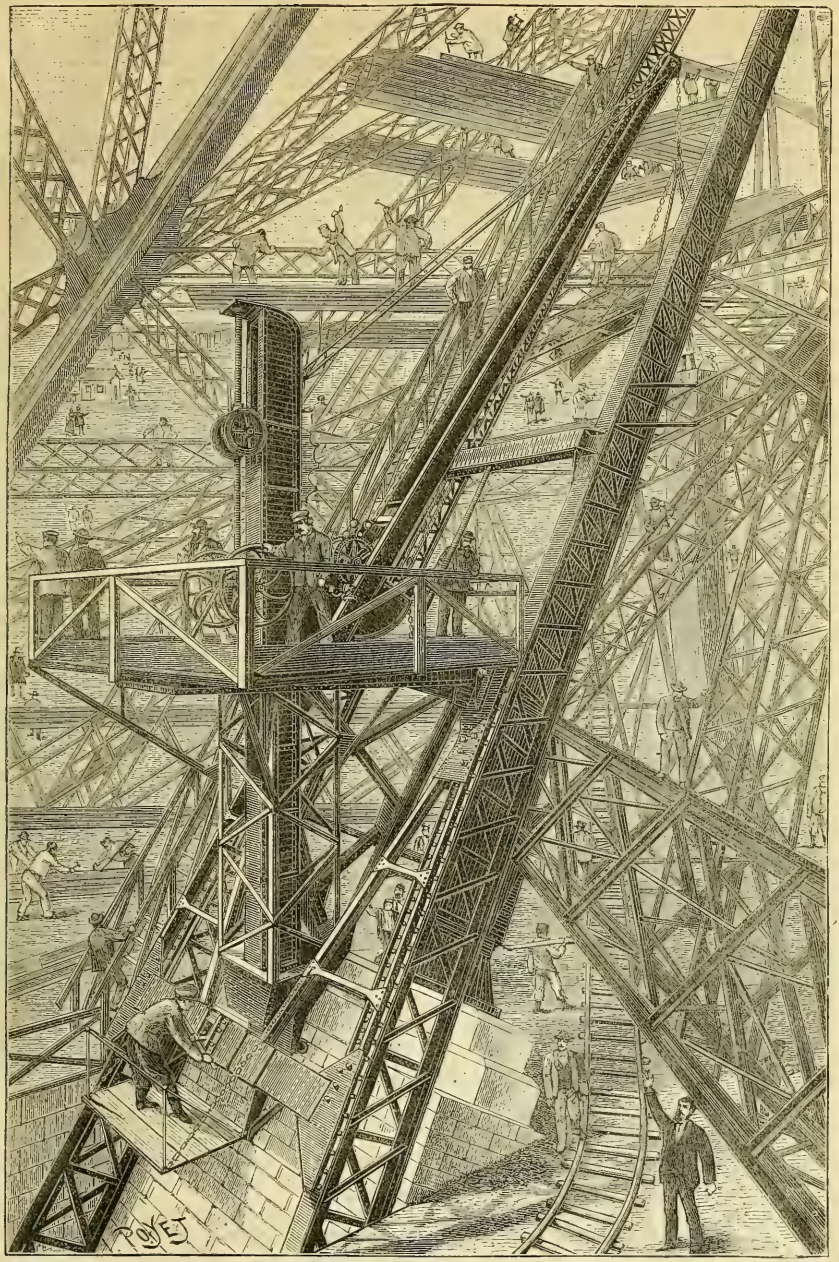
Professor Stokes ventures a forecast of the direction which future discovery may take. One cannot help thinking of one or two cases in which we seem almost in touch of what if we could reach it would probably give us an insight into the processes of nature, of which we have little idea at present. Take, for instance, the theory of electricity as contrasted with the theory of light. We can say that light consists in the undulations of an elastic medium. But we are not able to give a similar answer to the question, "What is electricity?" Referring evidently to the researches of Mr. Crookes and Mr. Lockyer on the "Genesis of the Elements," he thinks that relations of chemical composition may be pointed out even "between substances which we deem elementary, and which from their great stability we may, perhaps, never be able actually to decompose."

HEREDITY AND NURTURE.—Mr. Francis Galton recently gave at the South Kensington Museum the first of a course of three lectures on the parts played by these factors in human development. He proposed the establishment of an anthropometric laboratory, where any person might have his various dimensions and faculties accurately measured. Such a laboratory would include appliances for weighing, measuring, determining volume of chest, muscular strength, etc., and more delicate appliances for ascertaining the efficiency of the various senses and certain mental constants. A library would be attached, containing works on the respective influences of nature and nurture, including medical, hygienic, and statistical treatises in all languages. The lecturer solicits communications and suggestions from all persons who feel an interest in the project.

FOG AND SMOKE.—In a lecture, of which we give an abstract elsewhere, Sir Douglas Galton referred to the connection of these evils. He admitted that he was unable to give any decisive method of dealing with smoke. He proposes a trial of Professor Lodge's suggestion of discharging electricity into the air during fogs by means of a balloon or a kite. But he chiefly insists upon the prompt removal of dust, ammonia, and sulphur from the atmosphere and the prevention of the formation of smoke. He considers that we should cook by gas and must "sacrifice open fire-places, and probably the only way to effect this would be to levy a tax upon their use."

THE SMALL-POX HOSPITALS.—The recently-issued supplement to the annual report of the Local Government Board, containing the Medical Officer's Report for 1886, will possibly bring the question of these hospitals to a crisis. Sixty pages of an appendix are devoted to a discussion of the influence of small-pox hospitals in spreading that disease. Their consequences have long been dreaded, though the Asylums Board contended that any increase of small-pox in the neighbourhood might be referred to other causes. Mr. Power now shows that in every district where a small-pox hospital has been established there has been a serious rise in the mortality. If we compare the ten-years' periods, 1861 to 1870 and 1876 to 1885 (during which the hospitals of the Asylums Board have been brought into operation), we see that the small-pox deaths have increased yearly in Hackney from fourteen to sixty-three per 100,000; in Hampstead from five to sixteen. The same process has been going on in every district where a small-pox hospital has been established.

THE DEATH OF PROFESSOR BALFOUR STEWART.—We much regret having to put on record the sudden death of this eminent physicist. Balfour Stewart was born in Edinburgh in 1828, was educated at the university of his native city and in that of St. Andrews. Afterwards he spent some time in Australia engaged in commercial pursuits; but he soon turned his attention to science, selecting the absorption and radiation of heat. In 1859 he was appointed Director of Kew Observatory, where he remained ten years engaged in the study of terrestrial magnetism and of spectrum analysis. In 1862 he was elected a Fellow of the Royal Society, and in 1868 he received the "Rumford Medal" for his development of the equality of radiation and the absorption of radiant heat. In 1870 he was appointed to the chair of physics in Owens College, Manchester, the duties of which post he was fulfilling to within four days of his death. His works on different departments of physics are highly esteemed, but his most celebrated work, produced in concert with his friend Professor Tait, is the "Unseen Universe," which has already passed through twelve editions.



THE EIFFEL TOWER IN PARIS (*see next page*).

THE EIFFEL TOWER.

PROBABLY the most conspicuous object at the Exhibition to be opened in Paris next year will be the iron tower now being constructed by M. Eiffel. It will be no less than 1,000 feet high, or about two and a half times the height of our St. Paul's Cathedral. Visitors will be conveyed to the top by means of lifts, and from this great elevation there will be a splendid bird's-eye view of Paris and of the Exhibition. It is also proposed to establish a meteorological observatory at the top of the tower, and this cannot fail to be of scientific interest.

At first a site was chosen near the railway which separates the Champ de Mars from the square belonging to the municipality. This site was a very suitable one, but owing to objections raised by the authorities it became necessary to select another, where the nature of the soil has rendered the engineering difficulties somewhat greater. The foundations to receive the iron tower consist of four masonry piers, and two of these are built on hard gravel resting upon clay, whilst the other two piers occur where there is alluvial soil resting upon gravel, and this has necessitated much thicker beds of concrete under the masonry.

Each of the piers is a massive pyramid, vertical in front and inclined at the back, the upper surface on which the superstructure is built being inclined at an angle of 45 deg., as shown in the accompanying illustration—taken from a recent number of *La Nature*.

We need not trouble our readers with the technical details of the iron structure, especially as they are rather complicated. We may, however, mention that concave steel castings, weighing about five and a half tons, are fixed to each pier, for the purpose of receiving the bases of the iron columns. As these inclined columns grew in length, they were bound together by ties and lattice work, three of them being supported by staging, while the fourth was kept in position by the ties of the others previously fixed. A height of about 170 feet has already been attained, and the four columns are being joined together, and on this the first platform will be erected. During the progress of the work a temporary bracket is attached to the iron framework, and on this a crane is worked, as shown in our sketch, the crane being moved upwards as required by means of a long screw, and then reclamped to the ironwork. The girders which unite the four columns at the first landing each weigh about 69 tons, and M. Eiffel hopes to have this portion of the work completed early in January.

THE DEMAGNETISING OF WATCHES.

LONG before the days of dynamos, watches were injuriously affected by bringing them too close to powerful magnets, but it is not till lately that there has been real need for non-magnetisable watches, or for suitable protective cases. An American dynamo was exhibited not long ago, near which was a notice warning visitors that their watches might be injured if they approached too close to the machine; the inventor being apparently unaware that he was thus condemning the design, rather than extolling the strength of his magnets.

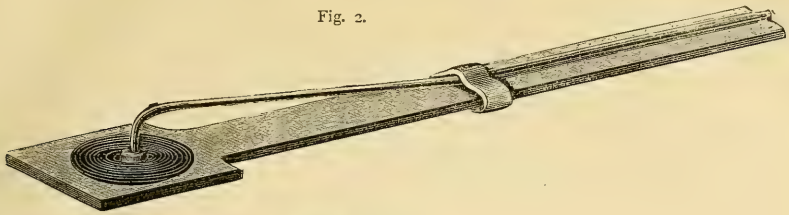
The effect of magnetisation is nearly always to retard or to stop a watch, though the reverse is possible. It should be observed that simple increase of friction will not make it go appreciably slower, but will merely decrease the swing of the balance wheel. The parts likely to be affected are the quickly-moving steel parts, or the stationary parts in close proximity to them. The hair-spring sometimes actually sticks together, partly owing to the influence of some more massive part in its neighbourhood. Palladium is used with success for hair-springs. It is a metal rather heavier than steel, and has the advantage of resisting corrosion. It is used both in its pure state and as an alloy; the resilience is not so high as steel, but it is quite sufficient for the purpose. Glass has been used, but the mechanical difficulties of fastening it in its place, and its liability to be broken by comparatively slight shock, have prevented its extended use. As a spring, however, it offers so great advantages that the method of manufacture may be worth describing.

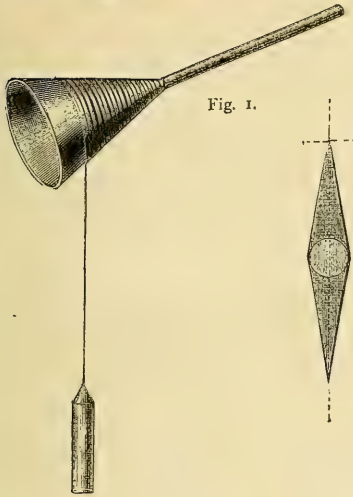
A thin metal cone (fig. 1) is mounted on a spindle, placed at an inclination, the broad end of the cone being open. A thread of glass is then drawn out to the required size, one end is attached to the top of the cone, the rod from which it is made being left hanging at the other extremity. The cone is brought to nearly a red-heat, by directing the flame from a blowpipe to its interior. The spindle is then slowly revolved, the thread of glass being softened at the point of contact with the cone, coiled into a conical spiral. When cool it is removed and pressed flat against a metal plate, on which the coils of the spring can be arranged evenly (as shown in fig. 2). The plate is then heated until the glass is again softened, and on cooling it retains the shape of an ordinary hair-spring.

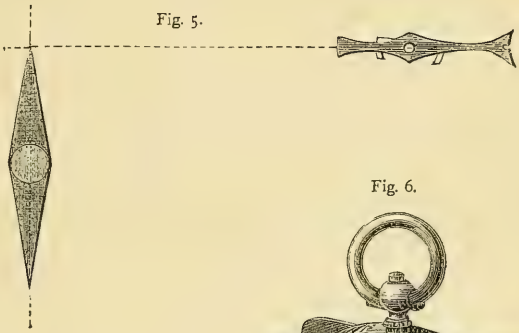
The balance-wheel is the part which is most liable to stop a watch by magnetisation. In a common watch this is made of brass, and therefore gives no trouble, but a compensated-balance is made of steel and brass. An arm of steel carries a ring, and round this is cast or shrunk a ring of brass (shown in fig. 3). A number of screws, with comparatively large heads, are set round the wheel for adjusting the weight. The compound rim of the two metals is sawn across in two places (a, a) near the arm. The reason for this arrangement is, that owing to the greater expansion of brass than of steel by heat, the result of a rise of temperature is to curve the rims inwards a little, and by thus tending to make the watch go faster, to counteract the retarding effect that would otherwise be produced. Regarding the steel portion as a magnet, it will be noticed that its polarity might take various forms, and the most difficult part of it to demagnetise is the tip of the rim at the saw-cut. A similar difficulty is met with in the regulator arm (fig. 4), when this is cut through at a for the purpose of giving it a spring grip. Not only is it almost impossible to demagnetise it thoroughly, but such an arm will rarely be met with in which iron filings are not found bridging over the saw cut. When it is remembered that an iron rod held north and south, with the north end pointing downwards, may be magnetised by a few blows with a mallet, it may easily be imagined that the act of sawing may be sufficient to magnetise a regulator, arm, or other part of a watch. Although magnetism is present to some small extent in many of the steel parts, no injurious effect is, under ordinary circumstances, observable, because the north and south poles lie in all directions at random.

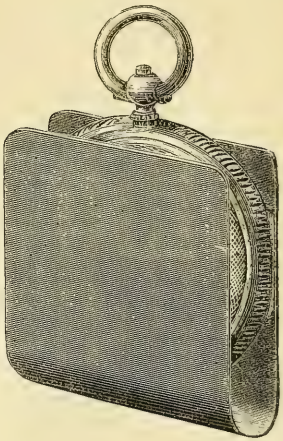
The 'scape wheel and the lever are important steel parts, and were it not for the ruby pallets which form the actual bearing surfaces, a trace of magnetism would have serious results. The only remaining steel portion,

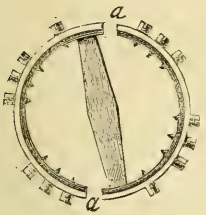
are the arbor and pivots. These could not exert any perceptible influence unless very strongly magnetised, when they might affect the lever or balance-wheel. It is difficult to remove all traces of magnetism from the netisation have been devised, but none of them is so certain as the separate demagnetisation of each part. In carrying out this remedy, there are two conditions of neutrality, both of which can rarely be attained. The











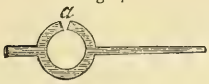


Fig. 2.

Fig. 1.

Fig. 5.

Fig. 6.

Fig. 3.

Fig. 4.

FIG. 1. METHOD OF MAKING GLASS SPRING. FIG. 2. FLATTENING COILS OF SPRING. FIG. 3. COMPENSATED BALANCE-WHEEL. FIG. 4. REGULATOR ARM. FIG. 5. TESTING MAGNETISM OF LEVER WITH COMPASS. FIG. 6. SHIELD TO PREVENT MAGNETISING OF WATCH.

shoulder of a pivot, and it will be found that iron filings will cling here when a delicate compass-needle shows no indication of polarity.

It is when a watch becomes magnetised as a whole that harm is done. Several different methods of demag- one is to make the part under treatment unable to pick up the smallest iron filing, and the other is to leave it so that it will not affect a compass-needle more than a piece of soft iron, which would feebly attract either pole. It is as a rule better to aim at the first of these conditions,

unless, which is not likely, it should, when almost perfect in this respect exert considerable influence on the compass.

The easiest method of demagnetising the separate pieces is, after carefully examining how it is magnetised, both by the compass and by iron filings, to oppose its magnetism by bringing an ordinary horseshoe magnet near it. A large magnet held at a few inches distance is better than actually stroking the part with a magnetised sewing needle, as the magnetisation of the latter is more liable to be altered than that of a large magnet. In some complicated parts, such as a compensated balance, it is necessary to use a needle. Balances have been constructed by M. Paillard of two different alloys of palladium having different expansive qualities. Phosphor bronze is used for levers, and might be used in conjunction with platinum for balances.

The balance-wheel is the most important part, for a watch provided with a non-magnetisable balance, though having spring, lever, regulator arm, and escape wheel of steel, will keep fairly good time after having been subjected to the influence of a powerful magnet, although it has been temporarily stopped while in the magnetic field.

To test a piece, such as a lever, with a compass, it is sufficient to offer first one end and then the other to the needle, holding it at right angles (fig. 5) and at a fixed distance. The needle should be attracted by either end, but should it be magnetised, one end will attract the needle, and the other end repel it, or only attract it feebly.

Sometimes the magnetism is destroyed by heating each part to dull redness, and re-tempering and polishing. Such a method cannot be recommended, as it not only involves considerably more labour, but is likely to do more harm to the watch than a little residual magnetism.

It is probable that the separate parts could be completely demagnetised by placing them one by one in the centre of a bobbin of insulated wire, like a small induction coil, but wound with rather thicker wire. A current should be sent through the coil, and rapidly alternated by means of a commutator, the strength of the current being at the same time gradually diminished by introducing a resistance. The piece under treatment would be magnetised first one way, and then the other, but with gradually decreasing strength. This method has been applied in various ways, with some success, to the demagnetisation of a watch as a whole, without taking it to pieces. It has the merit of simplicity, and does not need any knowledge of watch-making. The simplest way of carrying it out is to spin the watch rapidly, near a dynamo or powerful magnet, and withdraw it while spinning. This is almost always enough to start a watch which has been stopped, but its rate will probably remain affected. Mr. Maxim has constructed an instrument for the purpose; it consists of a magnet which can be rotated so as to present the north and south poles in succession, and a holder for the watch. This holder is attached to a long screw, and during the rotation of the magnet, the watch is gradually withdrawn from its influence. A similar arrangement has been used with an electro magnet, and provision is made for gradually reducing the strength of the current. These methods are free from the risk of injury which might occur from the violent spinning, but a very strong magnet would be required to destroy the effect of bringing a watch nearly into contact with the pole piece of a dynamo, an event which may often happen while it remains in the pocket.

There is one other method of treating the watch as a whole. It is placed on a table, face upwards, on a sheet of paper with two lines crossing at right angles. The dial is placed so that XII and VI are just over one line, and III and IX are over the other. The deflection of the compass is noted, and the watch is turned so as to bring I and VII over one line, and IIII and X over the other. The deflection is again noted, and a table made for the strength of the magnetism in each position. The maximum and minimum, or north and south points, can then be determined, and the watch is removed and passed backwards and forwards in front of a strong magnet in such a way as to neutralise the magnetism which has thus been measured. It must then be replaced and a fresh exploration made, and the process may be repeated until the compass fails to detect any unusual distribution of magnetism. Although good results are recorded as having been effected by this means, it can hardly he expected to cure effectually, unless in experienced hands, and it must be a tedious operation.

A complete protection from magnetisation is afforded by an iron case. It is not necessary that it should completely encase the watch, but it may consist merely o a piece of tinned iron, bent over with the corners rounded as in fig. 6. The effect is to offer an easy passage to the magnetic lines of force, which will then pass round, instead of through the watch.

UTILISATION OF FIRE DAMP.

IT is very interesting to see fire damp, the most dreaded enemy of miners, reduced by the genius of man to be his agent and servant, as has been done in Germany recently. The Wurm coal mines, near Aix-la-Chapelle, are particularly noted for the amount of fire-damp produced in them, and the minutest precautions had to be taken to prevent dangers that, notwithstanding this, were to be feared. Mr. Hilt, director of the mines, undertook the work. He constructed a line of piping that ran in front of all the centres of work and ended in a main pipe connected at the surface with a powerful suction pump.

But it was not enough to get rid of the noxious gas, it was necessary to utilize it; and so Mr. Hilt conceived the ingenious idea of causing the conduit to end in a gasometer. Upon isolating the latter, and placing wire gauzes here and there in the conduit, he was enabled to lead the gas to the furnace of two generators and use it to help to heat them.

We are obtaining, says the Director, 30,500 cubic feet of fire damp, which distil 263 cubic feet of water. On uniting the fire damp of all our exploitations, we shall have 64 cubic feet per minute, and shall be able to distil 5,260 cubic feet of water per twenty-four hours.

The utilisation of fire damp thus stored may become advantageous from a commercial point of view. It may serve not only for gas motors, but also, with well-constructed burners, for lighting purposes.—*La Nature.*

NAPHTHOL AS AN ANTISEPTIC.—Dr. Bouchard, writing in the *Comptes Rendus*, recommends naphthol as a powerful and relatively safe antiseptic, especially for internal use.

GENERAL NOTES.

MR. NEWLANDS AND THE ROYAL SOCIETY.—Mr. Newlands, the first discoverer of the periodic law, has, at last, received the Copley medal for this grand step in chemical theory.

THE GRESHAM LECTURES.—A reform is called for in the Gresham lectures, the subjects of which, as appointed by the founder, are astronomy, geometry, divinity, and music.

BORIC AND SALICYLIC ACID.—The use of these chemicals for the preservation of milk is increasing in England. In France the introduction of salicylic acid into articles of food or drink is forbidden.

THE PRESERVATION OF CIDER.—Both congelation and heating to about 60° C. have been tried in France for the preservation of cider, the former fruitlessly, and the latter with success.

WHAT IS AN ELEMENT?—Dr. J. Gibson, lecturing before the Andersonian Chemical Society, Glasgow, on the question, "What is an Element?" concluded that we could not as yet give a definite answer.

SLAUGHTERING BY ELECTRICITY.—Some experiments have been recently made in St. Petersburg with the idea of slaughtering cattle by electricity, the results of which have been highly satisfactory—death being in all cases instantaneous.

MYSTERY GOLD.—This alloy is composed of copper, silver, gold, and aluminium. Owing to the presence of the last-named metal the reaction of nitric acid upon copper is considerably diminished, so that it is difficult to distinguish it from gold.

BORINGS IN THE NILE DELTA.—According to a paragraph in *Nature*, the borings carried on in the Nile Delta by the Royal Society have been temporarily stopped by the breaking of the pipe. The depth reached is over 324 ft., but no solid rock has been arrived at.

SUB-CUTANEOUS TUBES.—There are millions of little tubes lying underneath our skins. It is estimated that on the average there are 2,800 of them to every square inch of the surface of the body. Every one measures when straightened out a quarter of an inch, and so we find that altogether there must be twenty-eight miles of this minute tubing beneath our skin.

ELECTRIC LIGHTING IN PARLIAMENT.—It is estimated that to light the whole of the buildings connected with the House of Lords and the House of Commons, 5,000 lights will be necessary. At present only 500 electric lights are used, and these have given such general satisfaction, that the impression exists that the necessary extension will be readily sanctioned.

EARTHQUAKES IN RUSSIA.—At the suggestion of Professor Mushketoff, who has just returned from his official visit to Semiretchia, a special commission has been appointed to watch the course of any earthquakes that may happen, and to report on them, in those parts of the Empire which are most frequently visited, such as the Caucasus, Turkestan, and the Transbaikal region.

TELEPHONE TO ST. BERNARD.—The monks of St. Bernard have established what is probably the highest-lying telephone connection in Europe, in order to facilitate their famous work of charity. Their well-known *hospice* is now in telephonic communication with the towns of Proz and St. Pierre in Switzerland and those of Fontine and St. Remy, on the Italian side of the mountain.

INTRINSIC LIGHT.—M. D. Monnier defines the intrinsic light of a lamp as the ratio of the photometric power to the area of the illuminating surface. The following figures are given as the intrinsic light of certain lamps:

Argand Burner	0·3	candle per sq. cm.
Siemens Regenerative Burner	0·6	,, ,,
Incandescent Lamp	30·0	,, ,,
Arc Lamp	480·0	,, ,,

SOLAR HALOS.—The iridescent ring or halo usually taken as an indication of approaching rain or snow, seen at times surrounding the sun, is known to most people. Occasionally outside this ring parts of other circles are seen touching it, but recently M. Cornu noticed these tangential arcs without the ring. He is of opinion that their appearance is due to the ice particles floating in the upper atmosphere becoming horizontal and strictly parallel.

THE CANALS OF MARS.—The curious "canals" on the surface of Mars are like nothing else known, and still remain unexplained. They are seen as nearly straight lines, and appear like cuttings, with parallel sides, extending from sea to sea across the planet's continents. They are about fifteen miles wide. They were discovered a few years ago by Schiaparelli, an Italian astronomer and their existence has since been confirmed by several other observers.

CULTIVATION OF FLAX.—Early last spring Messrs. Carmichael and Dalgleish offered, in order to revive the flax industry, to supply farmers in the vicinity of Dundee with flax seed for a thousand acres. Eighty farmers took advantage of the offer, and the reports now published with regard to the experiment show that although the crops have been somewhat light, the results have been such that several of the farmers are prepared to sow flax another year.

LONG-DISTANCE TELEPHONY.—The results obtained on the New York-Philadelphia line are so satisfactory that this line of telephonic communication is being rapidly extended. A line from New York to Boston with thirty wires, as well as another service to Albany, will probably be opened for traffic early in January. The wires are carried on poles from 45 feet to 50 feet high, which are strong enough to carry fifty wires, although only twelve will be placed at first.

TRAIN LIGHTING IN GERMANY.—From a report recently issued, containing statistics of the various methods employed in Germany for lighting railway carriages, it appears that gas is greatly in favour, and that at present oil is used to a limited extent. This improvement may however have the effect of retarding the general adoption of electric lighting, as the railway companies will be averse to abandon gas after incurring the expense of fitting up the carriages for it.

Heating Power of Carbonic Acid in contact with the Skin.—At the meeting of the Physiological Society of Berlin, on November 4th, Dr. Goldschneider discussed the fact that carbonic acid gas in contact with the skin produces a greater sensation of heat than air of the same temperature. This action is due, not merely to its greater power of absorbing heat and of producing a determination of blood to the skin, but to its direct chemical action on the terminals of the nerves, which are concerned in producing sensations of heat.

New Units of Length, etc.—M. de Freycinet (*Comptes Rendus*) proposes the following units in place of those of the metric system; the unit of length is the length of the velocity acquired at the end of a second of mean time by a body falling freely in a vacuum at Paris. This unit will be 0·98 metre. The unit of volume is a cube of which the side is $\frac{1}{100}$ of the unit of length. The unit of mass is the mass of water at 4·1°C. contained in the unit of volume. The unit of weight is the weight of the unit of mass. The unit of force = the unit of weight.

Temperature of the Baltic.—During the cruise of the steamer *Holsatia*, sent into the Baltic by the German Fishery Association for scientific research, it was found that off the island of Gottland, between Memel and the Hoberg Bank, the temperature of the sea at the surface was 55 degrees Fahrenheit, while 460 feet below the surface it was only 37·4 degrees. As this is one of the deepest parts of the Baltic, it has been suggested that a stream of cold water, coming from the Gulf of Bothnia or the Bay of Finland, may be the cause of this great variation in temperature.—*Nature.*

Electrical Transmission of Power.—The municipality of Geneva makes great use of the motive power supplied by the river Rhone; by means of turbines and pumps they provide the town and fifteen neighbouring communities with water, and furnish 145 manufacturers with power varying from half-a-horse to seventy horse-powers. Up to the present time hydraulic power has been supplied, but now the council is considering whether it would not be better to generate electricity at the source of power, as it could be taken so much more easily to the buildings where it is required.

Influence of Sleep on the Quantity of Carbonic Acid exhaled.—M. de Saint-Martin, in a paper communicated to the Paris Academy of Sciences, shows that natural sleep reduces the quantity of carbonic acid gas exhaled by about one-fifth, but lowers the quantity of oxygen absorbed only by one-tenth. In sleep occasioned by morphine the proportion of carbonic acid given off sinks to one-half, and during the sleep induced by chloral or chloroform to one-third of its normal value. During the state of insensibility occasioned by the latter agent, if sufficiently prolonged the blood becomes poor in oxygen and is loaded with carbonic acid.

Submarine Lighting.—According to *Industries* experiments made at the torpedo station at Newport, U.S.A., to ascertain the best way of illuminating the body of the sea below and in the immediate neighbourhood of a boat, have indicated a novel use for incandescent lamps. It was found that, by submerging incandescent lamps in the sea, a very effective light could be obtained. Each lamp is of 100 c.p., provided with a water-tight fitting and connections, and mounted upon a pole 20 ft. long, which is lowered vertically from the side of the vessel. By this means the body of the water is illuminated to a radius of 150 ft., though the light is not visible from a distance.

Sensitiveness of Taste.—Dr. F. P. Venables gives, in the *Chemical News*, the results of a series of experiments on the degree of dilution at which different substances can be tasted. Known weights of the substances were dissolved in water, diluted to known extents with water, and one cubic centimetre of the solution was tasted by each of two persons. The results were:—sugar, three ten-thousandths of a gramme barely tasted; salt, one-thousandth barely tasted; tannin, two ten-thousandths tasted, one ten-thousandth failed to taste; hydrochloric acid, one ten-thousandth barely tasted; strychnine, one two-millionth barely tasted. Thus the sensitiveness of taste must be admitted as inferior to that of smell.

Analysis of a Tear.—The principal element in the composition of a tear is, as may readily be supposed, water. The other elements are salt, soda, phosphate of lime, phosphate of soda, and mucus, each in small proportions. A dried tear, seen through a microscope of good average power, presents a peculiar appearance. The water, after evaporation, leaves behind it the saline ingredients, which amalgamate and form themselves into lengthened crossed lines, and look like a number of minute fish-bones. The discharge of tears from the lachrymal glands is not occasional and accidental, as is commonly supposed, but continuous, both day and night—though less abundantly at night.

Electrical Dissipation of Smoke.—It is said that the discovery by Professor Lodge of the curious effect of discharges of static electricity upon dust and vapour has been taken advantage of by Mr. J. G. Lorrain in the construction of an apparatus for the dissipation of smoke resulting from the discharge of ordnance. Mr. Lorrain proposed to employ an electrostatic generator, such as Wimshurst's, in communication with appropriate conductors arranged around the mouth of the gun, and as a conductor he prefers a light wire lattice provided with points. It is possible that such a device may be successful, but trials on a full working scale will be necessary before any definite opinion can be expressed.

An Improved Earth Plate.—An earth plate, which, according to Professor Dorn, reduces polarisation to a minimum, and which, therefore, should prove of great value to all observers of earth current, may be prepared by placing in a hole in the ground a flat open box, made of wood or cement, coated with asphalte. In this there is an amalgamated zinc plate connected with insulated wires leading to the surface, care being taken that the joint is properly protected. An earthenware pipe rising to the surface is placed upon the zinc; the box is then tightly packed with clay saturated with a concentrated solution of zinc sulphate, and the hole is filled up. Solid sulphate is dropped down the tube, and some of the solution poured after it. The plate may be kept in working order by adding a little fresh sulphate from time to time.—*Electrotech. Zeit.*

THE MAGIC LANTERN AS A TEACHING APPLIANCE.

THE magic lantern is not as yet sufficiently used by teachers of science, and it is hardly used at all by teachers of geography and history, to whom it might be of great service. Photographs of scenery or ancient monuments, and any other useful illustrations, whether engraved, painted, or photographed, may be shown in this way to a large class at once. The practical obstacles are reputed to be the costliness of the apparatus, the want of handiness in the teacher, and the inconvenience of the darkened room. These difficulties may be lessened by a little consideration of ways and means, and we shall endeavour to show how to deal with them. First as to cost. A good lantern is indispensable, but it need have none of the fashionable accessories. Dissolving apparatus and other complications, valued by the exhibitor of phantasmagoria, are entirely useless to the teacher. The price of a sheet-iron lantern, with condenser and photographic lens, is not prohibitive. The manipulation can readily be learned in an hour, and any one who can distinguish the taps, and is not too clumsy to slip a flexible tube on to a nozzle, may hope to succeed. No lantern-assistant is necessary. The teacher may easily work his lantern himself, provided that his room is large enough to give a clear working space of seven or eight feet. The lantern slides are rather expensive (1s. 9d. to 2s. each) at the usual rates, but amateur photography has improved of late to such a point that it is no longer vain to talk of good home-made slides, and several teachers might be named who turn out every year dozens of excellent lantern-slides. But let the beginner be cautious here. No more execrable object is known to us than a fogged lantern-slide. All defects are magnified, and strike the beholder with horror. "But the darkened room!" some will say; "what will become of the discipline of a class when all the lights are turned down to the blue? How take notes? How darken the room on a sunny morning?" The answer to these questions is, "Don't darken the room at all. Fix the screen in a darkish corner, and if necessary, shade it from superfluous light with a little black calico, and you will find contrast enough for a small disc illuminated by the oxy-hydrogen light. "It is often a good plan to fix the screen (an opaque screen, of course) in one of the windows; if used by night, it may be hung in advance of the gas brackets, or beneath a chandelier with an opaque shade just above it. The practical rule is to arrange matters so that the direct source of light, whether gas-jet, or sun, or sky, cannot be seen from any part of the screen. In the next place, If you wish to avoid darkening the room, you must be content with a small disc. A diameter of four or five feet is enough for all but very large rooms, and ample for an audience of 100 persons. You will find that the image is softened by the diffused light, and rendered much more agreeable to the eye. A brilliant light is necessary, and oxygen must be used. Condensed oxygen, thanks to the barium peroxide method of manufacture, which is now commercially available, is cheap and convenient. Use the iron bottle, and escape all the worry of leaky gas bags and all risk of the explosion of mixed gases. The oxy-hydrogen lantern, we venture to assure our readers, is a known and proved success when worked on these terms, and will vastly increase the resources of all who need graphic illustration. A little ingenuity, or a question now and then put to some practised operator, will remove any difficulty which remains.

If we have any influence with the makers of magic lanterns, we would urge them to give us for small class-rooms a short-focussed lens, which will give a five-feet disc at about six feet distance. Such a lens would greatly aid any teacher who wishes to work his own lantern.

WHY DO CLOUDS FLOAT?

OF all the paradoxes with which we are familiar, there is, perhaps, none which is less generally understood than the flotation and buoyancy of clouds. Whether it is the feathery cirrus or the golden bars and banks of the sunset sky—or

> "A cloud that's dragonish,
> A vapour, sometime like a bear or lion,
> A towered citadel, a pendant rock,
> A forked mountain, or blue promontory,
> With trees upon't, that nod unto the world,
> And mock our eyes with air,"

we have become so accustomed to disregard their weight, that we seldom wonder why such masses of vapour should float.

Their weight is no trifling matter. It is by no means unusual to find half an inch of rainfall in an hour, and this over a square mile means more than three thousand tons, or seven million gallons of water. We may therefore roughly estimate one of the substantial banks of cloud, so fancifully described by Antony, to weigh a thousand tons or so.

There have been not a few conjectures and theories, put forward by well-known men as attempts to explain the puzzle. They began, naturally, in the first place, to examine the structure or the material of which the clouds were composed, and they had little difficulty in most cases in perceiving minute drops; but here their examination of facts stopped, and they began to theorise. Saussure and Gay Lussac appear to have abandoned from the first the idea that the drops were solid. The name "vesicle" was given instead of drop, to begin with, by way of explaining that it was not an ordinary drop, or at all events that it had a "vesicular structure." In plain English, which even now is too often avoided in treating every-day matters from a scientific point of view, the drops were supposed to be hollow, that is, they were bubbles. The evidence for this hollowness is very small. The idea arose at first in all probability from a desire to find that they were lighter than ordinary drops of water; the wish was, in fact, father to the thought. But it is fair to note that Saussure himself "saw drops float slowly before him, rather larger than peas, whose coating seemed inconceivably thin." Without for a moment questioning the accuracy of this description, it will be admitted that such "vesicles" are rare phenomena, and are to be observed neither in the steam from a kettle, nor the cloud from a locomotive as it passes under a bridge on which we stand, nor in the chilly evening mist of a low meadow, nor do we find them on the rarer occasions on which we are at close quarters with an ordinary cloud on a mountain.

But were it proved that clouds are composed of minute bubbles we should be no nearer the solution of the problem, for not only would a pound of bubbles weigh as much as a pound of water, but owing to the elastic tension of the film the air inside each bubble would

be a little compressed, and therefore denser and heavier than the surrounding air. Gay Lussac remarks that a soap-bubble in a room descends, but if it is formed in the open air above a heated soil, the rising current pushes the bubble before it. This observation is no doubt correct, but the idea that all clouds are supported by conveniently arranged currents of heated air which balance them as in the Japanese butterfly trick is hardly worthy of further consideration. Gay Lussac, whose classical researches on the expansion of gases would alone place him in the first rank of the philosophers of his day, knew well that air has very appreciable weight, and that the problem was not to divest the water of which the cloud is composed, of its weight, but to show how it could become lighter than the surrounding air.

It has been argued that if clouds are composed merely of small drops, they ought always to show a rainbow when the sun shines at a suitable angle on them. There are, however, good reasons for supposing that in general the drops are so small that their dimensions may be compared with the length of a wave of light, and the absence of a rainbow goes to prove that they are of such minute size that the necessary reflection and refraction cannot take place in the usual way.

It must be remembered that clouds are not invariably composed of water; there are, unfortunately, such things as clouds of smoke and dust. Smoke is little else than fine particles of carbon, probably identical with soot. The cloud of dust on the high road is almost entirely mineral, simply of powdered flint or other stone. There can be no vesicular structure here, and though such a cloud does not float for long, it has a good deal more buoyancy than could have been expected of the material of which it is composed.

Fresnel, the distinguished French optician, pointed out that a cloud of minute globules of water or crystals of snow is composed of a mixture of such particles with air, and that the whole weight of water forms but a small fraction of the weight of the air. There is moreover what he called a multiplied contact with the air, that is to say, the innumerable particles expose a very considerable surface to the atmosphere. The air is, as it were, entangled with the more solid part of the cloud, owing to the friction at each surface. For no particle can move without carrying with it a coating or skin of air, which in turn cannot move through the surrounding air without considerable friction. The thickness of such a coating is only a few thousands of an inch, and its presence would not be felt unless the body it surrounds is both light and small compared with its surface.

It is somewhat difficult to estimate the proportion between the quantities of air and of water in an ordinary cloud. It must be remembered that cloud or mist is not the same thing as steam. Steam is as transparent and as invisible as air, it is only when it is chilled that it becomes a visible cloud. It is then no longer a vapour, but a mixture of minute particles of water with air. It probably occupies about the same space, and we know that such condensed steam by itself occupies less than the sixteen-hundredth part of its original volume. A cubic foot of air weighs about an ounce and a quarter; it is probable that the water in a cubic foot of cloud would weigh about a quarter of a grain.

Now pure air is as transparent to rays of heat as to rays of light, and therefore, since the heat can pass through without being stopped, the air does not become heated. Water absorbs a considerable quantity of heat rays, and Professor Tyndall has found that where the vapour of water is present in the atmosphere on a day of average dampness, its absorption is upwards of sixty times that of the air itself. When the sun shines on a cloud, each drop of water, not being perfectly transparent to the heat, becomes warmed, and in turn warms the air surrounding it, thus the great mass of air in which the drops are entangled, rises in temperature, and expands and becomes lighter than the surrounding atmosphere, and, as we have seen, the weight of the water being a mere trifle, it will rise until it reaches a level where the air is of the same density. It will float at this level in equilibrium. A cloud of smoke will behave in exactly the same way, and the equilibrium is so delicate that it has been noticed that the smoke of Vesuvius as it hangs over the mountain in still weather, rises and falls with every change of the barometer.

The flying of the gossamer spider may be accounted for in precisely the same way. The little creature has been observed to place itself at the extremity of a leaf, or some similar situation, and throw out a fine single thread. It chooses its position so that the thread is gently blown away by the wind, and when the thread is long enough it launches itself into the air at the end of its rope, which is not even attached to a "sky-hook." It is clear that the wind alone is not sufficient to account for the length of time during which it will sail about, and there is every reason to believe (especially as it may be noticed that it generally makes its excursions when the sun is shining) that the gossamer thread behaves like the drop of water, and becoming heated, warms its sheath of air, which dilates and thus bears up the thread and the passenger at its extremity.

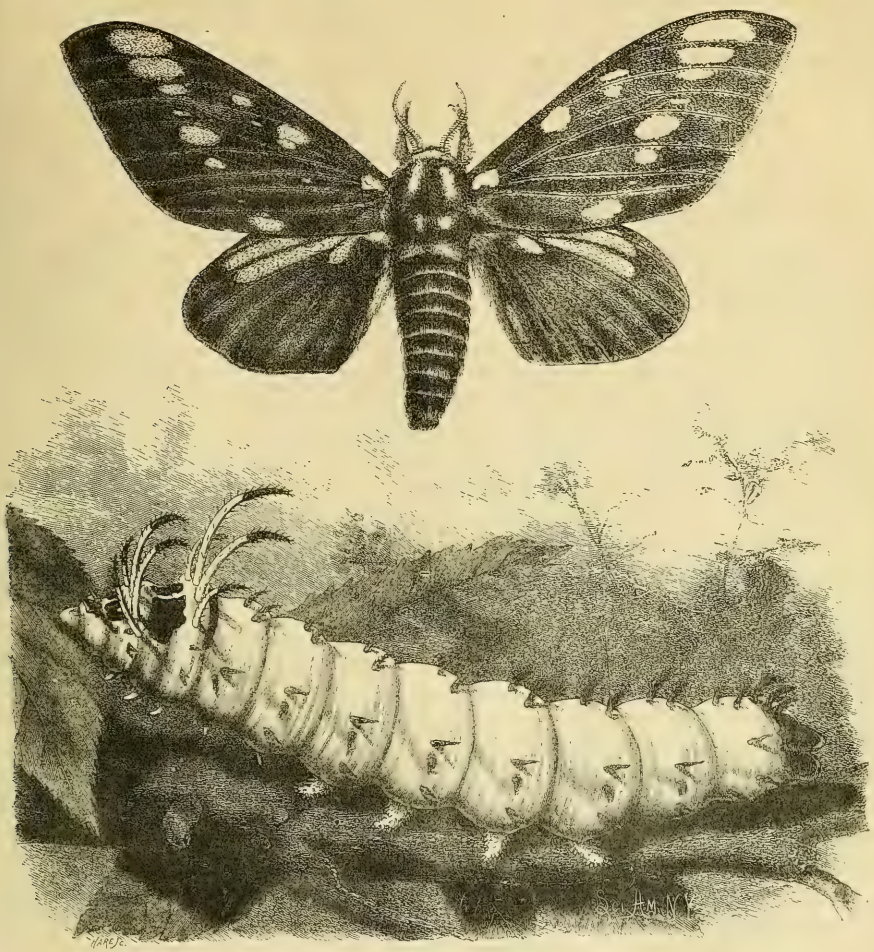
Although the buoyancy and the possibility of the rising of a cloud from near the earth to comparatively high regions is thus accounted for, we must remember that a pound of little water drops weighs as much as a pound of water, and is attracted to the earth with no less certainty. Professor Stokes has, however, shown how remarkably slowly a minute drop will fall through the air. This is in consequence of the viscosity or internal friction of the air. He tells us that a drop of water falling through air one thousand times rarer than itself (which we may suppose to be the case at the ordinary height of a cloud) would fall about eight-tenths of an inch in a second if its diameter were one-thousandth part of an inch. If the diameter of the drop were only one ten-thousandth of an inch the rate at which it would make its way through the air would be a hundred times smaller, or half an inch a minute. Some fogs are so heavily charged with moisture that they lie like lakes in hollows, and pour down valleys like streams.

There is, in conclusion, one more reason why clouds should float, and that is, that the little drops do not float in dry air, but in damp air. The vapour of water is much lighter than air, and damp air is lighter than dry air of the same temperature and pressure.

OWENS COLLEGE, MANCHESTER.—Bishop Berkeley (Research) Fellowships have been awarded to E. G. W. Hewlett, B.A. (Trinity College, Cambridge), in classics and philology; William Bott, Ph.D., in chemistry; and to O. H. Latter, B.A. (Keble College, Oxford), in zoology; and renewed for a second period to Henry Holden, B.Sc., in physics, and to William A. Shaw, M.A., in history.

NATURAL HISTORY.

THE REGAL WALNUT MOTH.—One of the largest and rarest of North American moths is illustrated by the accompanying figure, in which the imago and caterpillar of the *Ceratocampa regalis*, or regal walnut moth, are represented. This beautiful insect, in the winged state, flies during the nights of June and July, and can be found at rest with closed wings on fences or old trees during the day. The moth, when expanded, measures from five to six inches across the wings, and its fore wings have an olive-coloured ground ornamented by several yellow spots and heavy red veins, while the hind wings are orange-red, and each one has two irregularly-shaped yellow patches, and a row of wedge-shaped olive-coloured spots. The head and body of the moth are coloured orange and red like the hind wings, and the head is also adorned with two prominent feathered feelers. The thorax is yellow, with the edge of the collar and the shoulder covers of orange-red. A large orange-red spot is also found on top.



THE REGAL WALNUT MOTH *(Ceratocampa regalis).*

The females of this species of moth lay their eggs on the black walnut or hickory trees in July, and the caterpillars make their appearance about the beginning of August. The caterpillars feed on the leaves of black walnut and hickory trees, on which the eggs are hatched, and when fully grown attain the size represented in our

engraving, measuring from five to six inches in length, and nearly an inch in diameter.

The ground colour of the caterpillar is green, with a pale blue band on each ring, and a large blue-black spot is found on each side of the third ring. The most remarkable and attractive features of this caterpillar are its two rows of long, thorny horns or spines on the second and third rings of its body. The horns extend upward, and are gracefully curved backward, being of an orange colour, with black, pointed ends, and similarly coloured minute thorns or projections throughout their length. The smaller black spines are formed on each ring. The great size of this insect and its long thorns give it a wonderfully fine appearance when at rest, but when it is in motion, crawling along the twig of a tree, and shaking its head from side to side, or moving it up or down, it becomes really frightful to behold, although it is perfectly harmless, and cannot wound or sting with its horns or spines.

When fully grown, the caterpillar leaves the lofty branches of the tree, and crawls down the trunk to the ground, and there searches for a convenient place to change into a chrysalis. In this restless state it is frequently found crawling along a roadway or broad walk. As soon as it finds a convenient location, it goes into the ground to the depth of about six inches, and there builds a sort of nest or abode, having a level bottom and an arched ceiling, both being nicely cemented with a secretion emitted by the caterpillar, so that the nest has walls which are impenetrable to other insects and to moisture. After this grave is built, it strips off its skin, horns, jaws, and legs, and thus changes into a short, thick chrysalis, having a tolerably hard black shell. In this state it apparently slumbers throughout the winter, till about the middle of June, when it opens its shell, softens the cemented ceiling, and then crawls through the ground to the surface. When it reaches the latter, its wings are closely folded to its body, and are in a moist, soft state, so that it looks more like a grub than a butterfly. In fifteen or twenty minutes, however, the wings are loosened from close contact with the body, and slowly expand until all the veins are extended. They then become tightly stretched and hardened, and the full imago is then ready to rise and fly in the coming night to investigate the flowers and trees in the woods and fields, and to hunt for a congenial companion of its own species.—*Scientific American.*

Owls.—Owls hunt by night, and like other birds of prey, return by the mouth the hard indigestible parts of the food in the form of elongated pellets. These are found in considerable quantities about the birds' haunts, and an examination of them reveals the fact that owls prey upon a number of predacious creatures the destruction of which is directly beneficial to man. To show to what extent owls assist in preserving the balance of nature, it may be mentioned that 700 pellets examined yielded the remains of 16 bats, 3 rats, 237 mice, 693 voles, 1,590 shrews, and 22 birds. These truly remarkable results were obtained from the common barn owl, and the remains of the 22 birds were those of 19 sparrows, one greenfinch, and two swifts. The tawny and long-eared owls of our woodlands are also mighty hunters, and an examination of their pellets show equally interesting evidence. It must be remembered in this connection that Britain is to a great extent an agricultural country, and that if its fauna is comparatively small, it is not the less formidable. We have ten tiny field creatures, constituting an army in themselves, and, if not kept under, they would quickly devastate our fields. These ten species include four mice, three voles, and three shrews. Individually, so tiny are these that any one species could comfortably curl itself up in the divided shell of a horse-chestnut; but farmers well know that if these things are small they are by no means to be despised.

The Sense and Senses of Animals.—Sir John Lubbock, M.P., recently delivered an address on the above subject to the members of the Edinburgh Philosophical Institution. He said that one would gratefully admit that the dog was a loyal and true and affectionate friend, but when we came to consider the nature of the animal our knowledge was very limited. That arose a good deal from the fact that people had tried rather to teach animals than to learn from them. It had occurred to him that some such method as that which was followed in the case of deaf mutes might prove instructive if adapted to the case of dogs. He had tried with a black poodle belonging to himself. He then related several experiments he had made with pieces of card-board with different words marked upon them. He had taken two pieces of card, one blank and the other with the word "food" upon it. He had put the latter on a saucer containing some bread and milk, and the blank card he put on an empty saucer. The dog was not allowed to eat until it brought the proper card to him. This experiment was repeated over and over again, and in about ten days the dog began to distinguish the card with the letters on it from the plain card. It took a longer time to make the dog realise the difference between different words. In order to try whether the dog could distinguish colours, he prepared six cards, marking two of them blue, two yellow, and two orange. He put one of each on the floor and tried to get the dog to bring to him a card with the same colour as one which he showed the dog in his hand. After trying this for three months, he found that his experiment in this direction was a failure. He had always felt a great longing to know how the world appeared to the lower animals. It was still a doubtful point whether ants were able to hear. From experiments which he had made, he had come to the conclusion they had not the power of addressing each other. His impression on the whole was that bees and ants were not deaf, but that they heard sounds so shrill as to be beyond our hearing. There was no doubt about insects seeing. He then went on to relate several experiments he had made with the view of discovering whether different insects could distinguish different colours and had any preference for particular colours. The colours of objects must present a very different impression upon insects to that on human beings. The world to them might be full of music which we could not hear, colours which we could not see, and sensations which we could not feel.

Longevity of Birds.—According to the *Eleveur*, many birds, such as the eagle, the swan, and the raven, live more than a hundred years. The parrot, the heron, the goose, and the pelican have been known to live for sixty years; the peacock for 25 years, the pigeon 20, the crane 20, the linnet 25, the goldfinch 15, the lark 13, the blackbird 12, the canary 24, the pheasant 15, the thrush 10, the cock 10, the robin redbreast 12, and the wren only 3 years.

THE ALLEGED PURIFICATION OF WATER BY FREEZING.

THERE prevails a notion—to call it a superstition might seem discourteous—that if a body of impure water is exposed to a temperature below the freezing-point (32° Fahrenheit) the ice formed will be absolutely pure or very nearly so, whilst the impurities will be found collected in that portion which remains liquid. What may have been the origin of this supposition it might be very difficult to ascertain. But we find men of high standing giving it their sanction. Professor Tyndall is reported to have said that he could get no purer water than pure melted ice. In the first volume of Miller's "Chemistry" we read: "Indeed, water in the act of freezing becomes completely separated from everything which it held in solution."

On the faith of such authorities freezing was even proposed as a means of dealing with the sewage of London. It was to be exposed to intense cold and the greater part of it converted into ice. This, being supposed pure, was to be sold to fishmongers, and in short to all tradesmen who use ice in their business. The unfrozen part, retaining all the impurities in a concentrated form, might be easily used for irrigating meadows, etc. Fortunately, the economical aspect of this scheme appeared so unpromising, that it was never tried on a large scale.

But in a number of very careful laboratory-experiments, the ice when thawed was found rich in organic pollution. Our attention has been recalled to this subject by certain interesting observations made in the United States. In that country the use of ice in connection with food and drink is much more common than with us, and the supply is not always obtained from pure waters. Hence serious mischief has arisen, and sanitary chemists have been induced to make careful analyses of ice and ice water. Grape-sugar and white of egg in known quantities were dissolved in water, which was then allowed to freeze. The ice was found afterwards to contain, on the average, rather more than half the proportion of these substances which had been added to the water.

A very interesting difference was, however, noticed. Ice from water which holds in solution mineral matter, such as common salt, copperas, alum, or the like, will contain *less* of these substances than the water from which it was obtained, and by alternately freezing, redissolving in distilled water, and again freezing, nearly all the mineral matter may in time be removed from the ice.

With the organic impurities—the decomposing remains of plants and animals—the process is rather reversed, a pound of ice from polluted rivers containing more of such matter than a pound of the original water.

Thus, then, we see that water cannot be freed from its organic impurities by any freezing process. But what of foreign matter which is suspended in a solid form and not dissolved at all? Here, surely, every man and woman in the world blessed with eye-sight can make answer. Who has not seen in a frozen pool leaves, sticks, chips, the remains of dead insects, dust and bits of paper embedded in the ice? And if this is the case we may surely be convinced that smaller portions of solid matter, often much more offensive and dangerous than the above, will not be wanting. An appeal to the microscope will at once verify this conclusion.

But there is one form of solid or suspended impurity possible in ice which is of especial importance—pathogenic or disease-germs. No degree of cold with which we are acquainted can destroy these minute beings, though it may temporarily suspend their activity. Water from the clearest ice may swarm with them, though no want of transparency is perceptible in either. But it may be asked, Is there more risk of finding such microbia in ice than in water? We must say, Yes. Water may be, and often is, obtained from deep wells which has never been exposed to the atmosphere, and which contains no organic matter to serve for the nourishment of germs. But ice can only be obtained naturally from waters which have been spread out to the air, and into which consequently dust and dirt of various kinds must have fallen. So impure is the air that a prominent sanitarian even speaks of "previous sewage contamination" in the rain! It would, of course, be possible to conduct the water from some deep well into a freezing machine, all the internal parts of which should be artificially sterilised. But such ice is not to be had. All that can be done, therefore, for the present is to obtain ice only from the purest lakes or streams far apart from human dwellings and into which no sewage can possibly have found its way.

Some sad cases have occurred in America from the neglect of such precaution. In 1875, Rye Beach, in New Hampshire, was attacked by an epidemic of dysentery. Professor Nichols, of Boston, traced this disease conclusively to ice. No one was taken ill, save such as had been using a supply of ice from one particular source.

In 1879 another epidemic of dysentery broke out in Washington, Connecticut, and was traced by Professor Raymond, of Long Island College, and Dr. Brown, of Litchfield, to the ice which had been employed. Here, again, when the supply of that quality of ice was stopped the disease ceased, and only those suffered from it who had been indulging in the suspected ice. Here, then, is evidence which can be fully understood by every one, however little he may be acquainted with the niceties of microscopical research.

The epidemic of typhoid fever which broke out at Plymouth, Pennsylvania, in 1885, was produced by germs which must have been frozen up all the winter.

The most recent case of this kind was the intestinal affection with which most of the European visitors to the late Medical Congress at Philadelphia were attacked. They had conformed to the American custom of drinking iced water at dinner, and suffered accordingly.

It is startling to learn that most of the ice consumed in New York is obtained from the river Hudson *below* the towns of Troy and Albany. In these two towns the yearly average of deaths from typhoid fever is seventy-five, and all their dejecta are carried into the river.

Surely we do not go too far if we bid our readers beware of ice and of ice-water.

MANCHESTER.—The Council of the Technical School have recently purchased a valuable collection of apparatus, of German manufacture, illustrative of the principles of mechanism, and of sound, light, and chemistry in their technical applications. They have also made arrangements for a course of twelve lectures on "Chemical Engineering," to be delivered by Mr. G. E. Davis, late Government Inspector of Alkali Works. This school enjoys considerable prosperity, and is at present attended by 2,304 students, as compared with 2,136 at this time last year.

WILL-O'-THE-WISP.

NOT often has "dry" natural science to deal with the phenomena which figure in folk-lore. An exceptional case is afforded by the nocturnal occurrence known to the learned as *Ignis Fatuus*, and to the masses in different regions as Jack-o'-Lantern, Will-o'-the-Wisp, Wild- (or rather Wold) Fire, Friar's-Lantern, *Feu Follet*, *Heerwisch*, etc. The exception is the more noteworthy, as modern physics and chemistry have not succeeded in finding a satisfactory explanation of the facts. Facts they are beyond doubt. The *ignis fatuus*, though by no means common, has still from time to time been seen by competent witnesses, and occasionally by several persons in company. Nor is such evidence disputed. Let any man of sober habits and good repute state that he saw a Will-o'-the-wisp at such and such a time or place, and the most sceptical of our orthodox *savants* will listen with calm interest, and though he may question the narrator closely as to the details of the case, he will by no means proclaim it *à priori* impossible, or throw out any hints concerning "dominant ideas."

If we examine the most recent and trustworthy records of this phenomenon, we find it described as a light which appears in calm, mild nights, chiefly in summer or autumn. It is most commonly seen in marshy places, or where much organic matter is undergoing decomposition. Dr. Phipson describes it as most common in England "in the peaty districts around Port Carlisle in Cumberland, and on the Continent in the damp valleys between the pretty little university town of Marburg and that of Cassel, and more certainly still in the grave-yards outside the town of Gibraltar." The light is generally single, though sometimes two wisps have been seen together. It glides or bounds along at a variable speed, sometimes maintaining the same level, but at other times falling, rising, and overleaping hedges, trees, etc., and it may often be tracked to a distance of a couple of hundred yards from the spot where it originates, or rather where it is first observed. It is recorded as in many cases moving *towards* a pool or swamp, and there disappearing. The light is said to be globular, spheroidally elongated, or pear-shaped, about the size of "two fists," and varying in colour and brilliance, being at times visible even in the light of a full moon.

So much for points authenticated by the accordant testimony of trustworthy observers. Popular tradition goes much further. The spectators are said to have sometimes received sudden blows or shocks. According to an old German story, some village children having irritated a Wisp by crying out—

> "Heerwisch, ho, ho, ho!
> Brennst wie Haferstroh!"—

it pursued them into a house, and stunned every person present by blows with its fiery wings. Folk-lore, indeed, distinctly personifies the Wisp, and ascribes to it the intention to mislead the solitary traveller, and entice him into a swamp or pond. I cannot help here remarking that mediæval tradition personifies certain phases of the nightmare, as the terms Incubus and Succuba plainly testify. Some persons even now doubt if these phenomena are always purely subjective.

This view of the Wisp is by no means extinct, as will appear from the following extract from *Light*, June 24th, 1882. A contributor of that journal, who uses the *nom de plume* "Miror," gives the following account as told him by an old cottager:—

"'When a ploughboy, at Purbeck, I was sent to the blacksmith, who lived some distance off, with some harness to be mended. The blacksmith was at chapel; this delayed the work, and it was not till half-past nine in the evening that I could start for home. It was pitch dark, and as I went along a Jack-o'-Lantern came hopping before me. It was not above the size of your two fists. I was quite aware that Jack-o'-Lanterns come to lead you out of your path, so I kept my foot in the rut all along the country road till *he*, the Jack-o'-Lantern, hopped over a gate, where there was a pond close by, and tried to entice me there.'

"At the above very evident testimony of evil intention, the boy was overwhelmed with fright, and taking to his heels, rushed he knew not where, till he came to a house. There they took him in, and one of the inmates accompanied him over the fields, and put him on his way home.

"'I had not gone far,' continued the old man, 'before another Jack-o'-Lantern came hopping before me, and tried to entice me to a swamp which lay on one side of my way; but I knew where I was, and went straight for home, half dead with fear. Never again would I go to that blacksmith's of an evening.'

"'If he had not kept his foot in the rut,' broke in the old woman, his wife, 'it might have been all over with him. When a Jack-o'-Lantern gets you in the water, then he sniggers; he laughs, you know. I've heard my father say that scores of times.'

"Thus we see the old woman brought forward the testimony of her father also with respect to the traditional shady character of the Jack-o'-Lantern.

"'You call the Jack-o'-Lantern *he*,' I said. 'You talk as if you thought it knew what it was about, and by luring you into danger it had an object in view, and not a good one.'

"'Just so,' said the old man.

"On the man's assenting to the woman's assertion that 'when a Jack-o'-Lantern gets you into the water then he laughs,' I pressed the question, 'Do you really mean to say that they are *heard* to laugh—that they make the noise of laughter?' 'Yes,' was the reply. 'But how,' I rejoined, 'can people know that they laugh when those who are led by them get drowned, and do not live to tell it?'"

It is curious that "Miror" speaks of this his own objection—formidable, if not absolutely fatal, as it appears to us,—as "rather lame, special pleading." It must not be forgotten that the occurrence is said to have taken place at Purbeck. Now, in the West of England the tendency to personification is very strong, and the country people speak of many things as "he," which in the metropolitan district and in the north are always referred to as "it."

(*To be continued.*)

BETHNAL GREEN.—At the Memorial Hall, some instructive lectures, intended for working lads, have been given during the past month. Dr. Gerard Smith gave two lectures on "The Structure of Trees and Plants," and "Microscopic Life in the Sea;" and Mr. C. A. Newton delivered one on "The Wonders of the Heavens." Under the auspices of the Society for the Extension of University Teaching, Prof. H. G. Seeley, F.R.S., lectured on "Glimpses into Nature's Workshop." The first lecture dealt with the action of "Water: the Earth Leveller;" the second with that of "Ice: the Earth Engraver;" and the last with "Underground Heat: the Earth Moulder and Modeller."

REVIEWS.

Other Suns Than Ours; a Series of Essays on Suns—Old, Young, and Dead. By R. A. Proctor. London: W. H. Allen and Co. 1887.

We must confess to a feeling of disappointment on reading Mr. Proctor's latest volume. The title is suggestive of the interesting and carefully-written works of ten years ago, which fascinated the most unscientific readers by their attractive and fresh descriptions of the results of recent researches, and by the playful fancies of a daring imagination. The author has done immense service as a successful populariser of the driest facts, by stripping them of tedious figures and bewildering formulæ, without sacrificing that accuracy which constitutes the value of all scientific writing.

The first quarter of the book before us deals with stars, and is illustrated by two reproductions of the triple photographs of the brothers Henry (ouly a single image of each star is given), by several portions of star maps, and by an extraordinary "section from my chart of 324,198 stars," which conveys nothing but the idea that it has been printed from a sheet of rather coarse sand-paper. We do not get beyond page two before we are reminded that it is Mr. Proctor who is writing, and who must needs bring in the possible deals at whist as an illustration of a chance coincidence. Three pages later the tossing of a coin is given as an example of the calculation of probability. It is fair to add that these fads do not appear again until near the end of the volume.

The two serious faults which we find with the book are the constant repetition of arguments and phrases, and the lack of new and interesting matter. With one or two exceptions, the book is decidedly dull. We are told that Sir W. Herschel rejected the hypothesis of conical or cylindrical extensions of the stellar system in rich regions of the sky, and yet this phrase is repeated with trifling variations, twelve times in forty-seven consecutive pages. We have the quotation from Sir John Herschel four times over: "The access to the Nubeculæ on all sides is through a desert," each time we are duly informed that the Magellanic Clouds are being referred to. The book is no doubt a collection of essays which have already appeared in magazines; but a little care in revision would render this no disadvantage. In three chapters on comets which fail to maintain the interest of Mr. Proctor's earlier writings, the discussion of Schiaparelli's suggestion of the capture of a comet or a meteor flight by a planet becomes wearisome, for the problem is worked out in considerable detail in chap. ix., and appears again in the following chapter, which bears evidence of having been written as a separate essay. A chapter on sun spots is more readable, though it is not clear why it should bear the title of "A New Theory of Sun spots." Considerable stress is laid on the idea that the solar prominences are not actual eruptions of glowing hydrogen, but are trails in the wake of invisible projectiles. It should be noted that the author assumes that his readers are to some extent familiar with Biela and Le Sage's theory of gravitation; that "every one knows that the earth contains eighty-one times as much matter as the moon"; and that "doubtless every reader of these pages is familiar with the theoretical advantages of the great circle track"; this being so, it is surprising that in chap. xiv. on "A Dead World" he should try to enliven the subject by jokes which might be excused were they more witty and less vulgar. We are told that the alternations of temperature on the surface of the moon are such that they may vary from 282 degrees below freezing to 38 degrees above boiling. "The stoutest among us would be killed by ten seconds of such cold, as surely as he would be killed by one second in boiling water." Why water? there is none in the moon, and every frequenter of a Turkish bath is aware that with the simple condition of dryness a temperature decidedly above boiling-point is not only not fatal, but to many persons very enjoyable. In the same chapter it is stated that since sulphurous, boracic, and hydrochloric acid vapours are, at the present day, emitted by the earth's crust, that showers of "active acids, still intensely hot" and "fiery hot vitriol" used to form a feature of a climate that must have been anything but salubrious.

We have little to say on the "other science gleanings," which treat of heredity, germs, the misused H in England, and the morality of signalling in whist; they would be more in place in an additional volume of "Light Science for Leisure Hours," or some such collection, than in their present position. With careful revision and the addition of a few simple diagrams, in chaps. xi., xii., and xviii., "Other Suns than Ours" may be brought up to the level of Mr. Proctor's well-known and widely-appreciated writings.

Manual of Bacteriology. By Edgar M. Crookshank, M.B. (Lond.) Second Edition, 1887. London: H. K. Lewis.

That a second edition of this work should be called for a few months after the issue of the first is evidence alike of its value, and of the interest and importance of its subject. The new book is considerably larger than its predecessor, being of 439 pages instead of 249, and having seventy-three additional illustrations. Chapters on the General Morphology and Physiology of Bacteria, on Antiseptics and Disinfectants, and on Immunity, have been added.

In the chapter on Antiseptics and Disinfectants the author brings forward the views of Herroun on mercuric chloride, the fashionable antiseptic of the day. According to experiments made by Herroun, septic bacteria can be cultivated in albuminous filtrates, containing 1 in 2000 of the salt. However this may be, although the fact is generally ignored, there can be no doubt that the sulphur of albuminous bodies readily converts the chloride into the inert sulphide; and it is evident that the practical value of this, as of other antiseptics, has not yet received its full explanation. In the book before us our present knowledge and our present difficulties are clearly and fully stated.

The question of immunity or insusceptibility to infective disease is one of the highest practical interest, and we have never seen so concise and comprehensive a survey of the subject as we find here. Incidentally the author alludes to the degree of acquired immunity from certain diseases, which exists in civilized as compared with savage or isolated communities. We may point out that this seems an example of selection, whereby the most susceptible have been gradually eliminated, and the relatively insusceptible preserved; and that it indicates a danger associated with all efforts at protection successful on a large scale—the danger of the occurrence of devastating epidemics among artificially protected peoples, like those which so often almost destroy savage nations.

With regard to classification the author still follows the arrangement of Zopf, though looking upon it as only provisional. According to Zopf the difference between a bacterium and a bacillus turns on the presence or absence of endogenous spore-formation, a distinction certainly more scientific than that of the relation of length to breadth adopted by many English authorities.

As a practical guide to bacteriological study and experiment this book is without a rival, and the appendices on the examination of air, soil, and water are very concise and good. Its get-up reflects great credit on the publisher, and we consider that the new edition is much improved by the fact of the full-page plates having been collected together at the end of the book, and by the addition of a classified and amplified Bibliography.

Science-Lectures delivered before the Sunday Lecture Society, Newcastle-upon-Tyne. London: Scott.

This little volume contains a series of lectures, not equal in merit, but all of them decidedly interesting. They arrest our attention the more because they are devoted to the same task which we are attempting—the presentation of scientific truth in forms suitable for intelligent non-specialists.

We first find a discourse on the "Natural History of Instinct," by G. J. Romanes, F.R.S. "Instinct," as most of us know, is one of those pretty words which men have long been in the habit of using to bewilder themselves and their fellows. Ever and again they have brought forward this word to explain the actions of animals when it would have been more honest, and quite as satisfactory, to own their total ignorance. Mr. Romanes, however, lays before us a definition in which we can find little that can be objected to, and which will, we hope, in future restrain that abuse to which we have just referred. He writes:—"We may say that instinct is a term used to designate all those faculties of mind that are concerned in conscious and adaptive actions antecedent to individual experience, without necessary knowledge of the relation between the ends employed and the ends attained, but similarly performed under similar and frequently recurring circumstances of all individuals of the same species." We hope that our readers will bear this definition in mind when they meet with the term instinct in the older works on Natural History.

Some of the facts which the author advances in support or in illustration of his positions, are profoundly interesting. Thus:—"There is a kind of caterpillar, eight or ten of which live in company inside the fruit of the pomegranate. They eat out the fruit by degrees, and as they do so it withers; when it withers, the stalk is apt to break and allow the pomegranate to dry. It has been observed that in order to prevent this possible catastrophe—it is not a necessary catastrophe, as the pomegranate does not always drop—these caterpillars before they begin to eat out the inside of the fruit, carefully make a web, extending from the fruit to the branch, so as to act as a stalk in case of the natural stalk withering."

Many other curious facts are here mentioned which it is the less necessary for us to quote, as they may probably be before long discussed in a separate article.

"Animal Life on the Ocean Surface." By Professor H. M. Mosely, F.R.S., formerly of the celebrated *Challenger* exploring expedition. We can merely notice Professor Weissmann's explanation, here quoted, of the fact that a number of surface-haunting water animals descend some forty or fifty fathoms during the day-time and reascend as night draws on. The explanation is this: these surface animals, finding that floating vegetable matter extends to the depth of fifty fathoms, in order to economise their feeding-ground, which they cannot graze over without the aid of some light, feed on the food contained in the lowest levels when the sun penetrates down furthest. As the sun sinks, its light penetrates less and less deeply, and the animals gradually retreat to the upper surface, and there feed by the aid of starlight, or moonlight, if any.

The "Eye and its Work," by Dr. Litton Forbes, is a very clear exposition of the eye and its functions. In addition, there are some practical hints on the preservation of eye-sight, rendered timely by the increase of short-sightedness in schools. The author declares himself an opponent of over-pressure, of home-lessons, and of over-crowding. He protests against defective light in schools, and the use of badly-printed books. He might have pointed his moral by a reference to the prevalence of short-sightedness in Germany, where it has been fostered by the prevalence of school-books printed on a material little better than blotting-paper, and by the wretched German printing-characters, where the trifling distinction between letter and letter compels the reader to pore much more closely over the book than where the Latin characters are used.

Dr. Forbes further complains of a common reluctance to use spectacles when they are actually needed.

We do not doubt that such a feeling may be encountered, but far more common, we fear, is the idiotic affectation of using spectacles or eye-glasses when the sight is perfectly normal.

The "Movements of Plants," by E. A. Parkyn, M.A., is an exposition of a set of curious phenomena which have been chiefly brought to light by the researches of Charles Darwin.

The "Relations between Natural Science and Literature," by Professor H. Nettleship, is a paper dealing with relations not over amicable, though the author endeavours to hold out an olive-leaf to both contending forces. This subject, however, must be reserved for special consideration at the earliest opportunity.

"Facts and Fictions in Zoology," by Dr. A. Wilson, F.R.S.E., is an instructive and amusing glance over the mythical side of Natural History, with suggestions as to the possible origin of such fables. As instances may serve, the barnacle goose, the lamb tree, the sails and oars of the paper nautilus. But whilst the progress of science explodes many of the beliefs of our fathers, quite as frequently it proves that stories once derided as fables, have in them a basis of very substantial truth. Cuttle-fish—though they are by no means fish—have been actually caught measuring twenty feet in length of body, with arms twenty-four feet across. Such monsters are amply capable of overpowering a man in the water, or even of endangering small boats, and we are scarcely warranted in saying that the specimens taken are the largest in existence.

Dr. Wilson then declares himself willing "to hold a brief for the sea-serpent." He points out that none of the explanations suggested can account for such a case as that of the *Pauline*. Neither a flock of sea-fowl, nor a line of reefs, nor a quantity of floating wreck, nor a gigantic seal could do what the sea-serpent in that case is reported to have done, that is, coil itself round a sperm-whale and

apparently strangle it. Either, therefore, the master and crew of the *Pauline* really saw some huge serpent, or they gratuitously perjured themselves by making affidavit before the stipendiary, that they had witnessed such an encounter. There is here no room for mistake. We have merely the choice between fact or perjury.

Edinburgh Geological Society.—The Transactions of this Society (Vol. V., Part III.), recently issued, are replete with important matter. The first paper, by Ralph Richardson, F.R.S.E., discusses the antiquity of man, and the discovery of fossil mammalia in Devonshire and in Scotland. In the celebrated Kent's cavern indications of man have been found, not merely below a bed of stalagmite, five feet in thickness, every inch of which would, it is estimated, require about a thousand years to form, but in a black band below this stalagmite and in breccia still lower down. Mr. Pengelly thinks that the superficial black mould takes us back at least 2,000 years. Older than it was the granular stalagmite, and older again was the black band. But a still more ancient race of men lived in the days of the breccia, which is divided from the black band by the cave earth and the crystalline stalagmite. But whether this evidence pushes back the existence of man 60,000 years or 300,000 is by no means proven. Mr. Richardson, in summing up, declares that we cannot tell what primeval man was in Scotland by an examination merely of his implements and weapons and sepulchral remains. . . . The intellectual qualities of primeval man must remain, like the date of his existence, an insoluble problem.

Mr. James Thomson, F.G.S., describes the corals of the carboniferous system belonging to the genus *Lithostrotion*. Many interesting species of this group have been discovered at Ambigland in Kirkcudbrightshire, on the north side of the Solway Frith. By way of showing the structure of these beings we borrow the figures of *Lithostrotion basaltiforme* (Fig. 1), *Lithostrotion Dicki* (Fig. 2), *Lithostrotion Portlocki* (Fig. 3), and *Lithostrotion clisiodes* (Fig. 4), all in transverse section. How different must have been the climate of Scotland when corals could fringe its shores!

"The Lake Age in Ohio," by Prof. E. W. Claypole, B.Sc. (Lond.), is a most interesting study of the phenomena due to the Ice Age.

"Hutton's Views of the Vegetable Soil or Mould, and Vegetable and Animal Life," by James Melvin, will be to many persons a startling revelation. From a MS. work on agriculture, which has fortunately fallen into the hands of Mr. Melvin, it is plain that Hutton made important observations as to the origin and formation of the vegetable soil, and the laws which regulate the production of vegetable and animal life on the earth. He writes :—"It is to me a rational conjecture that a number of plants and animals were originally created and endowed with proper powers of generation, and from these all the plants and animals existing in the world are created." This language is not free from ambiguity. But whoever carefully examines the views of Hutton as here laid down will be inclined to award him no mean rank among the early advocates of Evolution. To this subject we shall endeavour by opportunity to return.

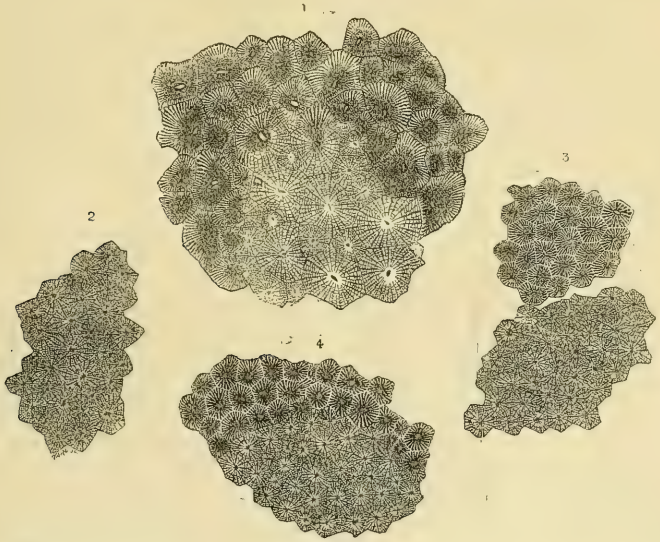


Fig. 1.—*Lithostrotion basaltiforme.* Fig. 2.—*Lithostrotion Dicki.* Fig. 3.—*Lithstrotion Portlocki.*
Fig. 4.—*Lithostrotion clisiodes.*

To Prevent Rust.—Melt together three parts of lard and one part resin in the powder. A very thin coating, applied with a brush, will preserve stoves and grates from rusting during summer, even in damp situations. For this purpose, a portion of blacklead may be mixed with the lard.

LAKE-BALLS IN SOUTH UIST.

ALL who delight in knowing about any new curiosity will be pleased to be told of the lake-balls found in the Island of South Uist. It is a remarkable fact that the loch of lower Kildonan in that small island of the Western Hebrides is the only loch in Scotland where the balls are to be found. In that loch, however, they are to be met with at the bottom in great numbers. Mr. G. W. W. Barclay has been lately examining these remarkable balls, and he has been told that they have existed there from time immemorial. No books on the Hebrides make any mention of them; and the inhabitants could give him no information on the subject. They are also found in several European countries; but, as we mentioned above, nowhere else in Scotland. The question naturally arises, how did these curiosities reach South Uist? The loch in which the balls are found is an irregular sheet of water, less than half a mile across in any direction. It lies near the west coast of the island, and is connected with the sea by the so-called "river" Boglass, which is a large ditch, eight feet broad and three quarters of a mile in length. The whole of the west side of the island is very flat, and Loch Kildonan lies only a few feet above the sea level. Except where the tide from the Boglass enters, the water of the loch is fresh. The tide, however, makes this part brackish; and it is in this place that the balls are found. Here the loch is quite shallow, and the bottom seems to be a mixture of sand and mud. The balls lie in a depth of two to three feet, and cover areas of many square yards, showing conspicuously by their dark colour against the light sandy bottom. They vary in size from about a quarter of an inch to four inches in diameter. Sometimes a complete ball is found inside a larger one. The balls are for the most part spherical, or nearly so. Mr. Barclay was told by a clergyman, who was fishing on the loch, that he had found one ball "as big as a hat." A microscopic examination of the balls shows that they are composed of a filamentous alga. In the interior of the ball are numerous diatoms, which in another form have been found of so great value in the deposits of the neighbouring island of Skye for the manufacture of ultra-marine and dynamite. Professor Fischer, of Bern, has been able to distinguish these algoid lake-balls according to the structure of the filaments and the size of the balls. They are found in Sweden, Germany, Austria, and Italy. He got one in Ellesmere, in England, with filaments longer and more silky than the specimens in South Uist, and of a somewhat different shade of green. There is now much speculation on the part of botanists and geologists as to how these lake-balls got into that remote western island of Scotland. Certainly it is one of the strangest among modern curiosities.

THE PURITY OF SALT.—The fact is probably not generally known that the salt mountains of Nevada, the salt island in Louisiana, as well as various other deposits of salt in different parts of the world, are almost absolutely pure chloride of sodium. It appears that of 22·28 per cent. of salts found in Great Salt Lake, 20·19 per cent. is pure chloride of sodium, and yet many of the streams running into the lake contain much larger quantities of other salts, some of the water being so heavily charged with nitrates and sulphates of soda and potash as to be unfit for animals to drink.

ABSTRACTS of PAPERS, LECTURES, etc.

THE ROYAL SOCIETY.

AT a meeting of the Royal Society on the 8th December, Mr. G. J. Symons read a paper "On the Detonating Bolide of November 20th, 1887." Mr. Symons said that shortly after November 20th, it was generally reported that an earthquake shock had been felt in the South Midland counties of England, and he began to collect and examine the facts. It appeared that the records from Oxfordshire, and the western stations generally, indicated that much louder sounds were heard there than at the eastern stations—*e.g.*, Essex and Cambridge. He thought that, although the phenomenon had been almost universally ascribed to an earthquake, it was more probably due to a explosive bolide, and on receiving from one of the local scientific societies a request for assistance in tracing the shock, he suggested the alternative explanation. Mr. Fordham had subsequently written to say that he had already found one person who saw the meteor from Hertford, which he described as "a brilliantly luminous body travelling across the sky from north-east to west." It was further stated that a portion of the meteor was seen to fall from the main body. Considering that the morning, as shown by the records of the Royal Meteorological Society, was both misty and cloudy, and that at time at which it appeared, Sunday morning, 8·20 a.m., there would be broad daylight, it was improbable that many persons saw it. Judging by the description of the noise, as well as the path roughly indicated by the Hertford observation, it seemed likely that it exploded over the south of Oxfordshire; but further details were much wanted. The meteor must apparently have been very large, as the explosion was heard or felt over an area of upwards of 2,000 square miles, the area being eighty-four miles in length, from about south-west to north-east—*i.e.*, from the confines of Wiltshire to Newmarket, Cambridgeshire, and of an average breadth of about twenty-five miles.

ROYAL METEOROLOGICAL SOCIETY.

AT the opening meeting, Mr. W. Ellis, F.R.A.S., president, in the chair, the following papers were read:—

(1) The Use of the Spectroscope as a Hygrometer Simplified and Explained," by Mr. F. W. Cory. The object of this paper was to suggest as simple a way as possible of using the spectroscope as a hygrometer in order to facilitate its introduction amongst observers as a standard meteorological instrument. The best form of hygrospectroscope as a recognised standard for the purpose of investigating and scrutinising the changes of the three parts of the spectrum mentioned, is that originally termed by Mr. Rand Capron "The Rainband Spectroscope." It ought to have a fixed slit, and in addition a milled wheel at the side for the easier adjustment of the focus. The author concluded by giving a set of hints to observers for taking weather observations with a pocket spectroscope.

(2) Rainfall on and around Table Mountain, Capetown, Cape Colony," by Mr. J. G. Gamble, M.A. The author called attention to the great and, in some respects, peculiar differences that exist between the quantity of rain that is registered on and around Table Mountain.

(3) "On the Cause of Diurnal Oscillation of the barometer," by Mr. R. Lawson, LL.D. The object of this paper was to show that the diurnal oscillation of the barometer is mainly due to the combination of the earth's rotation with its orbital motion.

ROYAL SCOTTISH SOCIETY OF ARTS.

The secretary, Mr. Lang, read a report on the "Correction of the Ship's Compass." At the outset he explained that the Society's Committee had reported regarding a compass by Mr. Moore, of Belfast, that they were in favour of his plan of attaching to the compass bowl, instead of to the deck or sides of the binnacle, the magnets and iron that corrected the deflector action of the iron in ships, and that it was an improvement in compass adjustment. Some correspondence arose from this, Sir William Thomson in a letter expressing disapproval of the theory which Mr. Moore advocated. Sir William said it would bring discredit on the Society of Arts to act on, or to give currency to, a grave theoretical error. Mr. Lang then entered into a defence of the position taken by the society. Mr. W. Bottomley, assistant to Sir William Thomson, maintained that magnets fixed to a ship's binnacles should remain parallel and perpendicular to the deck. When the ship heeled over the correction of the heeling error was entirely lost by attaching the quadrantal correctors to a bowl hung on gimbals. A serious and dangerous fault in the plan of attaching correctors to the bowl was the nearness of the correctors to the compass needles.

ROYAL BOTANIC SOCIETY.

At the last meeting of this society, Mr. J. P. Gassiot, Vice-President, in the chair, the secretary made some remarks upon the *Quercus coccifera*, or Kermese oak, and the dye-insect from which its name is derived, specimens of both being exhibited at the meeting. A common plant upon the shores of the Mediterranean, it has been from the most ancient times celebrated as the source of a very rich crimson dye, which until the discovery of the cochineal insect in America, was held in high estimation, and formed an important article of commerce, but is now almost entirely unknown, even in those places where it was formerly collected. Some interesting examples of the hardening of the constitution of plants by exposure were also exhibited, suggesting the inference that plants, like animals, are capable of being acclimatized.

INSTITUTION OF CIVIL ENGINEERS.

The paper read on 6th December was "Electrical Tramways: the Bessbrook and Newry Tramway," by Edward Hopkinson, M.A., D.Sc. Although a number of electrical tramways had been constructed in the United Kingdom during the last few years, there had hitherto been no attempt at the regular haulage of minerals and goods, nor at the operation of cars larger than the ordinary tramway type. Probably in no case had the effective power of any single motor exceeded about four horse-power. The principal object of the present paper was to describe the construction and to discuss the working of the Bessbrook and Newry Electrical Tramway, which had been designed for the haulage of heavy goods as well as for passenger traffic. The length of the line was rather more than three miles, with an average gradient of one in eighty-six, the maximum gradient being one in fifty. According to the conditions of the contract, ten trains were to be run in each direction per day, providing for a daily traffic of 100 tons of minerals and goods, and capable of dealing with 200 tons in any single day, in addition to the passenger traffic. It was worked entirely by water-power, the generating station being adjacent to the line at a distance of about one mile from the Bessbrook Terminus. There were two generating dynamos of the Edison-Hopkinson type, driven by belting from the turbine-shaft. The turbine could develop sixty-two horse power, and each dynamo was intended for a normal output of 250 volts, 72 amperes, though they were capable of giving a much larger output. The current was conveyed to the locomotive cars by a conductor of steel, rolled in the channel form, laid midway between the rails, and carried on wooden insulators nailed to alternate sleepers. At one point the line crossed the county road obliquely, the crossing being 150 feet in length. In this case the conductor on the ground level was not feasible, and an overhead conductor on Dr. John Hopkinson's system was substituted, by which the collector on the car consisted of a bar only, which passed under the supports of the overhead wire, and made a rubbing contact with its under surface. This system had been found to give very satisfactory results in practice. The trains were commonly composed of one locomotive car and three or four trucks; but frequently a second passenger-car was coupled, or the number of trucks increased to six. Thus a gross load of thirty tons was constantly drawn at a speed of six or seven miles per hour, on a gradient of one in fifty. The cars could be reversed by reversing the current through the motor without change of lead, but as there was a loop at each end of the line, reversal was only required when shunting in the sidings.

The author concluded the paper with a discussion of an extended series of experiments to determine the efficiency of the whole combination under various conditions, and the distribution of the losses. Under average conditions of working the total electrical efficiency was shown to be 72·7 per cent., the losses being distributed thus:—

Loss in generator	.. ..	8·6 per cent.
„ leakage	.. ..	5·7 „
„ resistance of conductor		6·6 „
„ motor	.. ..	7·7 „

The friction of the bearings in both generator and motor, and the power lost in the driving-gear, were excluded from these results.

In an appendix to the paper the cost of the electrical equipment of the line was summarised, and the cost of haulage per train-mile was shown to have been 3·3*d.* over one period of five months, when the goods traffic was light, and 4·2*d.* when the goods traffic was heavier. Since the opening of the line, the locomotive-cars had registered a train-mileage of 40,000 miles, the tonnage had exceeded 25,000 tons, and the number of passengers 180,000.

GEOLOGICAL SOCIETY.

On November 23rd, 1887, the following communications were read:—

1. "Note on a New Wealden Iguanodont, and other Dinosaurs." By R. Lydekker, B.A., F.G.S.

2. "On the Cae-Gwyn Cave." By T. McKenny Hughes, M.A. The subject fell into two divisions: The Age of the Drift outside the Cave, and The relation of the deposits in the cave to that Drift. The author contended that the drift outside the cave was of approximately the same date as the St. Asaph drift; and he discussed various difficulties, stratigraphical and palæontological, in the way of accepting the view that the cave-deposits were glacial, interglacial, or preglacial. For instance, he remarked that there were no marks of glaciation on the face of the rock in which the cave

occurred; that the cave-deposits were like drift because derived from it, but that no continuity existed between the drift and the cave-deposits; that there was a much greater thickness of rain-wash and resorted marine-drift looped down over the upper opening into the cave than over the adjoining surface. He maintained that we had now the clearest evidence as to the exact manner in which it was all brought about, namely, that the marine drift was deposited before the occupation of the cave by the animals whose remains have been found in it; that at the time of the occupation of the cave the upper opening now seen did not exist, but the animals got in by the other entrance; that against the wall of the cave where it approached most nearly to the face of the cliff, the drift lay thick as we now see it; that by swallow-hole action the cave was first partially filled, and then the thinnest portion of its wall gave way gradually, burying the bone-earth below it, and letting down some of the drift above it, so that some of it now looks as if it might have been laid down by the sea upon pre-existing cave-deposits.

ZOOLOGICAL SOCIETY.

At the meeting on November 15th, the Secretary said that amongst the recent additions to the Society's menagerie are a Red-and-White Flying Squirrel (*Pteromys alborufus*), from the province of Szechuen, in the interior of China, presented by Mr. Percy Montgomery, of Ichang, China; an Urva Ichneumon (*Herpestes urva*) and a young male Gorilla (*Anthropopithecus gorilla*).

At a recent meeting, Mr. G. A. Boulenger, F.Z.S., read an account of the Reptiles and Batrachians collected by Mr. H. H. Johnston on the Rio del Rey, West Africa. Amongst these were examples of two species of Batrachians new to science.

Mr. Edgar A. Smith read some notes on three species of shells obtained by Mr. H. H. Johnston, at the Rio del Rey, Cameroons.

Mr. A. G. Butler, F.L.S., read a paper containing an account of two small collections of African Lepidoptera, obtained by Mr. H. H. Johnston at the Cameroons and the Rio del Rey.

A communication was read from Mr. G. E. Dobson, F.R.S., on the genus *Myosorex*. The paper contained the description of a new species from the Rio del Rey (Cameroons) district, which he proposed to call *Myosorex johnstoni*, after Mr. H. H. Johnston, who had sent home the specimens.

Mr. G. A. Boulenger gave the description of a new species of *Hyla* from Port Hamilton, Corea, living in the Society's gardens, which he proposed to name *Hyla stepheni*, after its discoverer.

PHYSICAL SOCIETY.

At the meeting held on December 10, 1887, Prof. W. E. Ayrton, Vice-President, in the chair, amongst the papers read was one by W. H. Tomlinson, on the Recalescence of Iron. He states that if an iron bar which has suffered permanent strain be heated to a white heat and allowed to cool, the brightness at first diminishes and then reglows (recalesces) for a short interval. Under favourable circumstances as many as seven reglows have been observed during one cooling. Generally two decided ones are observed, one between 500° and 1000° C., and the other below 500° C. The author believes these effects are due to "retentiveness" of the material, somewhat similar to the causes of residual magnetism and residual charge in a Leyden jar. A table of experimental results, giving the torsional elasticity and internal friction at different temperatures, for iron wire, showed sudden increases in internal friction at temperatures of about 550° and 1000° C.

NOTTINGHAM MECHANICS' INSTITUTE.

Time and Tide.—Sir Robert Ball, the Astronomer Royal for Ireland, gave, in a lecture on "Time and Tide," the romance of modern science. He remarked that he called his subject a romance because it would require efforts of imagination on the part of his audience to aid them in looking back into the very remotest recesses of antiquity. When he spoke of antiquity he did not mean the paltry centuries with which historians had to deal, nor did he allude to the thousands of years which had elapsed since Babylon and Nineveh were great and populous cities. Even the pyramids of Egypt, which loomed up to them from the midst of the past, seemed as but yesterday when compared with the eras of years beyond. A thousand years exhausted all historic time; ten thousand years certainly did. Geology told them that ten thousand years was but a moment in the span of man's history. They spoke of nothing anterior to the time when the earth assumed the dignity of eternity and brought forth its first and only child. The earth at the time of this birth was a huge inorganic mass, too hot for life, perhaps hot enough to be soft and viscid, if not exactly molten. It was a rude inorganic mass, and time had wrought wondrous changes both in parent and child. Many went in the summer to the seaside and were well acquainted with the daily ebb and flow of the water, which they called the tide. In the ebb and flow of that tide they had an engine of mighty power. The sun contributed in some degree to the making of the tides, but the moon in a much larger degree. At present the tides were not a source of power which could be worked economically, but a time might come when that source of natural energy might have to be utilised—a time when the price of coals rendered the use of the steam engine exorbitantly expensive. From a scientific point of view, the work done by the tide was of incalculable importance. Where did they get their power from? The source of energy on which the tides drew was not found in the moon, but in our earth itself. He asked them to liken the globe to an immense fly-wheel, 8,000 miles across, rotating once in a day with a rapid motion round its axis, and containing a vast store of power which the tides drew upon when they wanted to do work. As this power in the earth was called upon to do the work of the tides the consequence was inevitable. The power was decreasing, and the earth therefore must be losing some of the speed with which it was turning round, and consequently the tides were slowly increasing the length of the day—an increase which might amount in a thousand years to a small fraction of a minute. The earth was constantly being troubled by the incessant ebbing and flowing of the tides. The earth reacted on the moon and tended to push it away, so that the moon was gradually going away from the earth. As thousands of years rolled on the length of the day lengthened second by second, and the distance of the moon increased mile by mile. There was a time when the moon was in contact with the earth, which was then spinning round in a period of four or five hours. They could calculate that a time would come when the earth would require 1,400 hours to go round, and that would be at the same time when the moon had got such a distance from the earth that it would take a month of 57

days to traverse its course. As the moon went round the earth would turn round in the same way, so that the faces of the two bodies would be kept towards each other. When that state of things happened, the tides would no longer flow, because as the earth was turning with the moon it would always remain high tide at one place and low tide at the other, so that the ebbing and flowing of the tide would cease and the earth and the moon would continue in harmony and peace to rotate round one another. The chief alteration would be that our day would be 1,400 hours in length instead of 24.

PARKES MUSEUM OF HYGIENE.

Sir Douglas Galton, in a recent lecture on smoke and fog, said that if people could be impressed with the fact that the greater part of the evil of black fog was preventible, and if each person would endeavour to mitigate that evil, our light and air would cease to be obscured. The black canopy always hanging over us strained our eyesight and lowered our vitality; we felt the acrid nature of the London fog in our breathing. Dr. Russell's experiments showed that the air in a fog contained four times as much carbonic acid as ordinary London air, and that this might be taken as an index of the quantity of other impurities which a fog accumulated around us. Fog was caused by the floating matter in the air attaching to itself the aqueous vapour which was always more or less present. Some forms of matter, such as ammonia and sulphur, had a greater affinity for the vapour than other matters. These substances were present in London air to an unnecessary extent. The ammonia arose from the manure which the authorities took no pains to remove from stables; and if dustbins were emptied frequently, so as to remove all organic matters rapidly, and if the streets were properly cleansed instead of such a quantity of horse manure being allowed to remain on the pavement, one potent cause of fog would be removed. The blackness of London fogs arose from the smoke proceeding from incompletely burnt coal. There was no doubt that factories had furnished much smoke; but the efforts which had been made in recent years showed that the formation of smoke was absolutely unnecessary. It might all be prevented. Fires of boilers were quite easily made smokeless, either by proper care or mechanical stokers. Bakehouses, potteries, and other factories might be entirely smokeless if gas were used, and this had been done by Messrs. Minton and others. But the domestic fires caused most of the foul smoke, and this evil daily increased with the increase of London. If this smoke was to be abolished, it would be necessary in the first place to use gas for cooking—the open fire could not be retained. All experience showed that the open fire must be given up, although it had great advantages in that it warmed the walls and furniture, and left the air of the room cool to breathe, and therefore more exhilarating. With open fires dust did not attach itself to the warm walls and furniture so much as it did in a room heated by hot-water pipes or by hot air, which heated the air of the room, but left the walls cold. If smoke was to be avoided, houses must be warmed by hot air, hot water, steam, or gas, which should be applied so as to warm the walls or dados and floors, and then some of the comfort of the open fire would be experienced; and it was to be hoped that, in the progress of invention, electricity would be resorted to for warming as well as lighting rooms.

TECHNICAL EDUCATION NOTES.

City and Guilds of London Institute.—At the recent distribution of prizes Sir John Lubbock took occasion to praise the work of the Institute, and mentioned that when, in 1880, it took over the work originated by the Society of Arts the number of candidates examined was 816. They had increased every year since, and at present the number of students was 10,224. There were no less than 460 classes.

Victoria University.—This university has prepared a scheme of examinations, both pass and honours, to which the students attending the classes of registered mechanics' institutes or technical colleges will be admitted. This is an important step in the advancement of technical education, especially as the University intends that the scheme should be readily accessible to all institutions desiring to avail themselves of it.

Glasgow.—At a recent meeting of the Glasgow Philosophical Society, Mr. Henry Dyer read a paper on "The Technical Schools Act, and Some of its Relations to Elementary and Higher Education." He pointed out that various matters, such as free education, voluntary schools, the re-organisation of secondary education, should have been considered, and technical education made an essential part of the national system before the Technical Schools Act was passed.

Manchester.—The trustees of the late Sir Joseph Whitworth have spent £47,000 in buying a plot of about twenty-five acres of land, in one of the best situations in the city. They offer this to the Corporation of Manchester on condition that two-thirds are maintained as a public park, and that the other is to be used for the following institutions: (1) an Institute of Art; (2) a Museum of Commercial Materials and Products; (3) a Technical School on a scientific and practical scale. It has also been stated that the trustees will probably contribute towards the cost of the buildings.

Finsbury.—A conference on "Technical Instruction in relation to Apprenticeship and to the National Organization of Education" was recently held at the Technical College, Leonard-street, City-road, under the presidency of Sir John R. Jennings (of the City and Guilds Institute). The necessity for technical education was generally recognized, and the following resolution was passed:—"That this meeting is of opinion that technical instruction should supplement, not supplant, apprenticeship, and that, if taught by practical workmen under the supervision of scientists, in laboratories and workshops, it is calculated to be of great benefit to British industry."

Bradford.—The council of the Technical College have passed the following resolutions, which have been presented to the Vice-President of the Council on Education, namely:—"(1) That the improvement and development of our manufactures can only be expected from the technical training of youths of special ability, and not from the technical education of children in general, which would prove most burdensome to the ratepayers, and, so far as improvement in manufactures is concerned, would be comparatively useless. (2) That it is desirable that technical schools be established in the centres of the different manufacturing industries, with special reference to the industry or industries of the locality. (3) That no technical education will give efficient aid to the development of our manufacturing industries unless it is given in schools furnished with the newest and most approved machinery employed in each particular industry and given in buildings specially adapted for such machinery. (4) That exhibitions entitling their holders to free education in these schools be granted to boys who excel in the examinations in art and science. (5) That the governing council of technical schools be a representative body, consisting of representatives of the Town Council or local authority, the Chamber of Commerce or Agriculturist, and such public educational institutions of the town or neighbourhood as the School Board and Mechanics' Institute, in addition to representatives of donors to the building or subscribers to the maintenance of the technical school or college."

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

MOLEHILLS UNDER SNOW.

Have any of your readers observed the peculiar forms of molehills which are sometimes thrown up by moles under the snow? Instead of the usual tumulus-like heaps, I have seen the molehills lying arranged in more or less symmetrical ridges of uniform height and breadth. Of course, it is known that in their laborious work of excavation, moles require to get to the surface of the earth here and there, to dispose of the loose material which they have scraped out. If, in their work, they come upon a hard road, they get out and run across it, and start afresh again. When frost cakes the ground for some time, they will run for some distance on the surface to endeavour to get a softer field of operations. Now it would appear, that underneath a heavy wreath of snow the moles make galleries about the size of their own bodies, on the surface of the turf in the bottom of the snow, into which they push the earth to be disposed of. Though the temperature of the air is much below freezing, the surface of the sod, under a heavy wreath of snow, is never frozen, and the moles can continue their work. They cannot make the heaps on account of the weight of snow, and they make these tunnels. Have any others observed this?

MOLE.

A CURIOUS PHENOMENON.

I was told lately of a very curious phenomenon by an intelligent observer. In sailing with one of the pleasure steamers on the West Coast of Scotland, on a very calm day, he observed the reflection of coast objects clearly pictured in the smooth surface of the water, but with everything, of course, inverted from its real position. But strange to say, further out from the shore, he observed a reflected image of this last picture, with everything standing up as in the original position on the coast. Have any of your readers observed this mirage-like phenomenon in similar circumstances on the West Coast, or elsewhere? What is the cause of the appearance? I should be glad to get an explanation.

OBSERVER.

SERPENT POISONS.

It is commonly reported in South America that any person who has been bitten by a venomous serpent and recovered is henceforth proof against all tropical fevers. Do you know any facts which ever support or controvert this popular belief?

SURINAMENSIS.

ELECTRIC SEWAGE TREATMENT.

May I ask whether as far as you are aware electric currents have been used, on anything like a practical scale, for the purification of sewage and waste waters? I am aware that electric action has been proposed for this purpose in several patents.

S. P. E.

MICRO-ORGANISMS AND THEIR CAPABILITIES.

Your recent article, "A word for Germs," is suggestive and may be accepted as an instalment of the truth. But it might, I submit, have been carried further. These tiny beings will very probably play in the future no unimportant part in the manufacture of organic products. Indigo is doubtless not the only valuable article which is or may be generated by germ-action. But the activity of these minute organisms may, perhaps, do mankind more service in the destruction of vermin. Attempts have already been made to occasion by their means epidemics among locusts, house-flies, rats and field-mice. With reference to the rabbit-plague in Australia, for the extirpation of which the colonial government of New South Wales has offered a reward of £25,000, we find that M. Pasteur proposes to launch against them fowl-cholera, a disease which does not seem to extend to the larger domestic animals nor to mankind.

But whenever any novel power is put into the hands of mankind, there are always certain persons who apply it especially to evil purposes, and sometimes indeed, as in the case of the so-called "high explosives," the evil may outweigh the good. A lamentable instance of disease-germs being used for a criminal purpose has occurred in Chili. A man who entertained an intense hatred for a neighbouring family, contrived, during an epidemic of malignant small-pox, to procure some of the "crusts." This matter he mixed up with tobacco and dropped it near his neighbour's house. The tobacco was found and smoked, the germs being probably volatilized and absorbed before they could be destroyed by the heat. The consequence was the death of the entire family. Nemesis, however, did not sleep. This inventive murderer himself took the infection and confessed his crime just before death.

SIGISMOND.

EFFECTS OF ELECTRIG LIGHT UPON BOOKS.

An attempt has been made to prove that the electric light is, after all, more injurious to books than gas. It is certainly true that if paper, made from wood-fibre, is exposed to the electric light, or indeed to the sun or to strong daylight, it will turn yellowish, whilst gas-flames do not produce any similar effect. But gas burning in a library acts upon the bindings of books, not merely when they are opened out for reading, but all the time as they stand closed up on the shelves. So that, even if we leave the risk of fire out of the question, the electric light is far preferable for libraries. What might be the case if we could produce gas absolutely free from sulphur, I cannot say.

A BOOK-WORM.

AUTOMATIC ADDITION.

While adding up some long columns of figures a little time ago, I noticed that I arrived at 100 at about the same part of the page each time. The sum came to 100 at about the twenty-second line of from the bottom. If we take one column at a time, the possible numbers vary from 0 to 9; the average value of a figure is therefore $4\frac{1}{2}$, and since 100 divided by $4\frac{1}{2}$ is 22·22, if we had a book ruled with an average of 22·22 lines to a page, the totals would be in each case conveniently near 100. How far this would be a convenience I do not know, but it might be of use in getting out rough statistics. In the same way, the average value of any figure in the pence column is five pence halfpenny, and columns containing an average of 43·63 figures will have a sum of about £1. In adding shillings and pence, the average on each line will be 9s. $11\frac{1}{2}$d., so that 20 lines will give very nearly £10 for the sum of the shillings and pence, provided that there were no tendency for the figures to run in whole numbers or small amounts.

A. P. T.

JUBILEE COINAGE.

Enough outcry has been made about the wretched design and execution of the Jubilee coinage, but your note on page 222, describing the production of the dies from which it was struck by the electro-deposition of iron and a plaster model, shows how the means were worthy of the ends. I do not think that Mr. Ruskin goes so far as to say that a work of art on which a great time has been expended, on account of the difficulty of working the material, will necessarily be more noble than one which, owing to mechanical facilities, has been completed more rapidly; but he has certainly pointed out, that the greater skill called forth in the former case, together with the close application and consequently deeper study and love for the work, is in favour of a better result; and it is evident that the harder material offers much greater scope for the artist's skill. What wonder, then, when the softest, most friable, and least polishable material was used, that the results were cheap and nasty?

W. S.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

ORGAN BLOWER.—A pneumatic action for organs has been patented by Mr. M. Hetherington, of Wallsend-on-Tyne, whereby the entire action is worked by pneumatic pressure only, instead of by pressure and exhaust, and may be worked with one uniform pressure throughout the instrument. The action also is simplified and the wind employed economised.

HORSE-SHOE.—Mr. Charles Howieson, of Dollar, N.B., has patented a horse-shoe. A permanent inner shoe, not subject to ordinary wear, is fitted to the horse's hoof, the outer surface of which is made flat with the exception that projections are made at the toe and calk parts, to which an outer wearing shoe, formed with the usual wearing calks and toe-point, can be attached.

PETROLEUM FUEL.—The use of petroleum as fuel in stoves forms the subject of a patent by Mr. E. O. Eaton, of Martin's Lane, London. A metal wire cylinder is provided, and filled with asbestos, or other incombustible material of absorbent qualities, to absorb the oil which will burn for a length of time proportionately to the amount absorbed. A tin can is provided for the reception of the cylinder.

HEATING AIR.—An apparatus for heating air to a high temperature has been patented by Mr. J. A. Eaton, of Cannon Street, London. To prevent the air passing too quickly through the heating chamber, a number of baffle plates are fixed at intervals along the chamber, and so arranged that there is a space at top and bottom alternately for the air to pass over and under, and thus become more effectually heated.

UNDERGROUND TELEGRAPH WIRES.—A method of laying and insulating underground telegraph wires has been patented by Mr. T. O. Callender of 101, Leadenhall Street, London. He joins together "in situ" troughs of any desired dimensions, preferably rectangular in shape, made of bitumen concrete, so as to form one continuous case for the conductors. The latter are first insulated with the bituminous material and protected in the usual manner by tape braiding.

AUTOMATIC FIRE EXTINGUISHER.—An automatic fire extinguisher patented by Mr. J. B. Hannay, of Dumbarton, N.B., consists in charging the branch pipes which supply water to the sprinklers with air. When a sprinkler valve opens, by the action of heat due to fire, the air first issues, but is immediately followed by the water. Suitably placed gauges show if leakage of air through the sprinkler valves takes place and the charge of air can be renewed from time to time.

SMOKELESS FIRE-GRATE.—A smoke consumer for domestic fire-grates forms the subject of a patent of Mr. J. F. J. Browne, of Ealing Dean, Middlesex. The usual register opening is closed up, and at the back of the grate a false back is arranged with a space behind; in this space is a second plate to compel the smoke to pass downwards, and on turning round the bottom of second plate passes into the chimney. The fire makes the false back red-hot and thus consumes the smoke as it passes down behind.

METHOD OF GENERATING ELECTRICITY.—Mr. C. J. Woolly, of Grand Rapids, U.S.A., has patented a method of generating electricity. It consists in the utilization of heat generated in a steam-boiler, or which is radiated from pipes through which the products of combustion pass, in connection with a thermo-electric pile, which is applied thereto in such a manner as to generate an even, steady current of electricity to charge the dynamo used for electric-lighting, telegraphy, etc., etc.

A CAR COUPLER.—Mr. E. J. Hill, of 6, Westminster Chambers, London, has patented a car coupler. It consists in the employment of an arm pivoted to the head-stock of the waggon, and in suspending the end link of the coupling from a chain passing over a sheave at the end of the arm, and thence to the side of the waggon; the arm is preferably mounted on an inclined axis so that its free end will rise as it slews outwards, and will naturally tend to swing back against the head-stock and carry the coupling with it when the latter is uncoupled.

MANUFACTURE OF ALUMINIUM.—An improvement in the manufacture of aluminium is the subject of a patent of Mr. Edward Cleavers, of Stockwell, Surrey. This is effected by baking alumina and dissolving it in sulphuric acid. The sulphate of alumina thus obtained is mixed with finely-divided carbon, which when dry is heated out of contact with air, thereby causing a reduction of the alumina salt. The material so obtained is mixed with iron in a divided state, and the temperature raised sufficiently to melt the metal, when an alloy of aluminium and iron is obtained.

SELF-WINDING CLOCK.—An electrically-wound clock has been patented by Mr. W. J. Barnsdale, of Brunswick Place, City Road. According to this invention electrical contact points or springs are placed with relation to the centre wheel, and a corresponding pin wheel driven thereby or acting in unison therewith. The winding is effected by means of the revolving armature of an electro-motor, which acts upon suitable wheel trains in connection with the mechanism, but such motor is only actuated when the circuits are completed through the contact points, and ceases to act so soon as such circuit is broken.

AUTOMATIC FIRE EXTINGUISHER.—Mr. William Mayall, of Mossley, Lancashire, has patented an automatic sprinkler. In this invention a valve is mounted inside the perforated sprinkler, the spindle of which passes through the casing to the outside, where it is supported in position by a lever, the larger arm of which is soldered to a bracket with a metallic soldering compound consisting of lead, tin, bismuth and cadmium, mixed together in such proportions as to melt at a temperature of about 160° F., thus permitting the valve to fall and water to be supplied to the sprinkler as soon as the temperature rises sufficiently.

ANNOUNCEMENTS.

HAMBURG.—An exhibition of machinery of all classes will be opened in this town during this year.

KING'S COLLEGE, LONDON.—The Council have recently resolved to have a great increase of commercial education, both in the college and in the school.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—The Council has definitely decided to recommend the alteration of the name of the Society to "The Institution of Electrical Engineers."

VIENNA.—An International Jubilee Exhibition of works of art will be opened during this year. Intending exhibitors must give notice by the 15th inst., and all exhibits must be delivered by the first of February next.

ANTARCTIC EXPLORATION.—The Council of the Royal Geographical Society have agreed to recommend the Government to grant £5,000 to the Australian Government in aid of the proposed Antarctic exploring expedition, for which a similar sum has already been provided by the Australian Government.

INTERNATIONAL GEOLOGICAL CONGRESS.—The fourth session of the International Geological Congress will be held next year in London. The Organizing Committee appointed to carry out the arrangements will nominate the officers and fix the exact day of meeting, which will probably be held between August 15 and September 15.

FRANCE.—Dr. Darin has decided to found a dispensary for the electrolytic treatment of cancerous diseases with the 300,000 francs left by the late M. Henry Giffard, who also bequeathed 50,000 francs to each of the following, viz.:—the Academie des Sciences, the Société des Amis des Sciences, the Société des Ingénieurs Civils, and the Société d'Encouragement.

PARIS UNIVERSAL EXHIBITION, 1889.—This exhibition will be opened in Paris on the 5th of May, 1889, and pending the formation of a British Central Commission, applications for admission and space should be addressed to the French Consulate General, 38, Finsbury-circus, London, E.C., or to the French Consulates in Liverpool, Glasgow, Dublin, Newcastle, and Cardiff.

THE BARCELONA EXHIBITION.—The buildings erected in a large park in the centre of the city are rapidly approaching completion, and will be ready for the reception of exhibits early this year. The total area of the grounds of the Exhibition is 74 English acres; the main building contains 500,000 square feet, and there are, besides machinery galleries, an art gallery and annexes for agricultural implements.

SENATE OF PHYSICIANS AND SURGEONS.—A petition has been presented to Her Majesty in Council by the Royal College of Physicians of London and the Royal College of Surgeons of England praying for the grant of a charter under the style of "The Senate of Physicians and Surgeons," with power to grant degrees in medicine and surgery. The petition will be considered by a Commitee of the Privy Council on January 16.

LICK OBSERVATORY.—It is stated that Mr. E. E. Barnard, director of the Vanderbilt Observatory, Nashville, Tennessee, has been appointed an astronomer at the Lick Observatory, Mount Hamilton, California. Mr. J. M. Schaeberle, assistant in the Ann Arbor Observatory, has also received an appointment as astronomer at the Lick Observatory, both appointments having been made on the recommendation of Prof. E. S. Holden, the director.

PHOTOGRAPHIC EXHIBITION AT THE CRYSTAL PALACE.—An exhibition embracing every branch of science or manufacture connected with the art of photography will be opened at the Crystal Palace in February next. Already valuable exhibits have been promised, and it is anticipated that the collection of pictures and apparatus will be larger than at any previous exhibition, while the classification will be far more complete. Medals and certificates will be awarded for competitive photographic lantern slide entertainments.

DIARY FOR NEXT WEEK.

Monday, Jan. 9.—London Institution, 5 p.m.—*Invisible Stars*; Sir Robert S. Ball, F.R.S.
Aristotelian Society, 8 p.m.—*Darwinism in Relation to Design*; Mr. G. J. Romanes, F.R.S.

Tuesday, Jan. 10.—Institution of Civil Engineers, 8 p.m.—*The Use and Testing of Open-hearth Steel and Boiler-making*; the late Mr. H. Goodall.
Photographic Society, 8 p.m.—*Stereoscopic Work*.

Wednesday, Jan. 11.—Society of Arts. Second Juvenile Lecture on *The Application of Electricity to Lighting and Working*, by Mr. W. H. Preece, F.R.S.

Thursday, Jan. 12.—London Institution, 6 p.m.—*The Material of Music*, by Prof. W. A. Barrett, Mus.Bac., Oxon.

Friday, Jan. 13.—The Institution of Civil Engineers. Students' Meeting, 7.30 p.m. *Railway Engineering in British North America*; Mr. R. J. Money.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Electro-plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Nickel Plating.—Batteries, Nickel Saltes and Anodes. Every requisite.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Horizontal Engine, 8 Horse Power, Pump, and Governors. Complete, £25. A bargain.—W. H. MORGAN, Engineer, Gloucester.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

Books.—All kinds supplied. "Sprague's Electricity," new, 12s. 6d., post free.—PARKER, 160, Great Hamilton-street, Glasgow.

Before deciding, send **2d.** for list of Second-hand **Lathes, Fret-saws. Mechanics' Tools.**—BRITANNIA CO., Colchester. Makers of Engineers' Tools to the British Government.

Large assortment of **Tools,** etc., on view, 100, Houndsditch, London.—All letters to BRITANNIA WORKS, Colchester. *Bona-fide* makers of 300 varieties.

Saccharine.—300 times sweeter than sugar. Sample 1s. free.—ADLINGTON, Boughton Fields, Worcester.

Meerschaum and Briar Pipes Repaired, mounted, or cased, ambers fitted.—W. GEORGE, 374, Essex-road, Islington, London.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

BOOKS RECEIVED.

"Liver Fluke and Rot in Sheep," E. Halse (Stanford).—"Inorganic Forms," H. H. Higgens.—"Journal of the Scottish Meteorological Society."—"Bird Stories," H. Weir (Society for Promoting Christian Knowledge).—"Experimental Chemistry," E. Reynolds (Longman and Co.).—"Photographer's Indispensable Handbook," H. Sturmey (Iliffe and Sons).—"Manual of Bacteriology," E. M. Crookshanks (Lewis).—"Science Lectures at Newcastle" (W. Scott).—"The Stevens Indicator" (the Stevens Institute).—"My Hundred Swiss Flowers," M. A. Pratten (Allen).—"Living Lights" (S. Low and Co.).—"Student's Handbook of Chemistry," L. Greville (Livingstone and Co.).—"Colour," A. H. Church (Cassell).—"Proceedings of the Cleveland Institution of Engineers."—"Chemistry of Building Materials," A. J. Evans and A. Grenville (Bateman).—Catalogue of Scientific Books, Collins (W. P. Collins).

Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

PROFESSOR HUXLEY ON TECHNICAL EDUCATION.—In the course of an address delivered at the Town Hall, Manchester, in support of the National Association for the Promotion of Technical Education, Professor Huxley said that the system of our primary education had the defect which was common to all the educational systems which we had inherited. It was too bookish and too little practical. The child was brought too little into contact with actual facts or things, and, as it stood at present, it constituted next to no education of those particular faculties which were of utmost importance in industrial life—the faculties of observation of accurate work and of dealing with things instead of with words. He laid great stress on the teaching of drawing for children. They might take the commonest objects and lead a child from them to truths of a higher order. He thought that the training of ordinary school-teachers was not favourable to the production of good science and technical masters.

HIGHER EDUCATION IN RUSSIA AND ITS DIFFICULTIES.—Strikes and lock-outs are unhappily not strange to us in Britain, though they have not extended to our Universities. What might be the case if the students here were treated as they are in Russia it would be easy to imagine. Trifling ebullitions, which would have signified little if the offenders had been treated with a little of the *leniter in modo*, have assumed formidable dimensions. At present all the Universities in Russia proper, with the exception of Kieff, have been closed, and the entire undergraduate class is in revolt. The Technical, Agricultural, and Veterinary Institutions are in the same condition. It appears that at one time the Czar Nicholas contemplated suppressing the Universities in his dominions. His successor, Alexander II., was less jealous of mental cultivation. Under the present Czar restrictions have been again multiplied. The rectors, curators, and professors are compelled to play the part of spies and beadles. The result of the struggle will be sad enough for the unfortunate youths engaged or supposed to be concerned with it, and will immensely strengthen the hands of the Nihilists.

THE ISOLATION OF FLUORINE.—After three years of incessant labour, M. Moissan has at last succeeded in obtaining fluorine in the free or uncombined state. The existence of this element has been known for nearly a century, and it is interesting that its properties, as described in the *Annales de Chimie*, agree exactly with the predictions made concerning it on theoretical grounds. It is, when in the free state, a permanent gas, occupying the first place in the so-called halogen series, where it is followed by chlorine, bromine, and iodine. Its affinities are more energetic than those of any other known elementary substance, and this circumstance has been the chief cause of the difficulty attending its isolation, since it at once combined with the reagents employed and corroded and destroyed the apparatus. With hydrogen it combines, even in the dark, and at the temperature of 23°C., with a violent detonation.

THE MANUFACTURE AND STORAGE OF PICRIC ACID.—In consequence, doubtless, of the serious explosion

at the works of Messrs. Roberts and Dale, Cornbrook, Manchester, picric acid and the picrates are now, by an Order in Council, declared to be explosives coming within the provisions of the Explosives Act. Hitherto they have been regarded as explosives only when manufactured for military or engineering purposes, but not when for use in dyeing or printing. This distinction was not very logical, since they were equally dangerous whatever the purpose for which it or they were ultimately designed. The only exceptions are picric acid wholly in solution and picric acid manufactured or stored within a place exclusively devoted to such storage and in such a manner as to prevent it from coming in contact with any basic metallic oxide or oxidising agent, or with any detonator or other article capable of exploding picric acid, or with any fire or light capable of igniting it. We may add that the use of picric acid in dyeing has much declined.

French Vintage for 1887.—Official returns for the past year show that, in spite of all efforts, the vintage in France is still going on from bad to worse. The quality of the wines is spoken of as rather improved, but they are pronounced very deficient in alcoholic strength, and the quantity of sugar used in ameliorating the wines has increased from 6,031 tons used in 1885, and 27,410 tons in 1886, to 34,982 tons. The total production of wine has been 546,797,000 gallons as against 553,923,000 gallons in 1886. In twenty departments there has been an increased yield, but in forty-seven we perceive a falling-off. The decrease affects some of the most important wine-growing districts, such as the Côte d'Or, the Haute Garonne, the Charente, and the Charente Inferieure. In these two last departments, the production is only one-twentieth of what it was in 1875. It is sad that such mischief should have been wrought by the stupidity of persons who would import American vines. Saddest, perhaps, when we reflect that the decline in the consumption of wine, and the substitution of malt liquors and ardent spirits, has led to a great extension of drunkenness in France.

Death of Prof. A. Dickson. — We much regret having to put on record the death of Dr. Alexander Dickson, Professor of Botany at the University of Edinburgh. The deceased was born in Edinburgh in 1836, and died on December 30th, apparently whilst engaged in the game of "curling" on the ice. He had graduated in medicine at the University of his native city in 1860, but he turned his whole attention to botanical studies. In 1862 he temporarily occupied the botanical chair at Aberdeen during the illness of Prof. Dickie. Four years later he was appointed to the Botanical Chair at Dublin University, and in 1868 he held also the Professorship of Botany at the Royal College of Science, Dublin. The same year, however, he became Professor of Botany at the University of Glasgow, where he remained until 1879, when he became Professor of Botany in the University of Edinburgh, and Regius Keeper of the Royal Botanic Gardens. His published researches entitle him to a place in the first rank of philosophic botanists. He contributed about fifty important memoirs to the *Transactions of the Royal Society of Edinburgh*, and he was also a frequent contributor to the *Journal of Botany* and the *Edinburgh New Philosophical Journal*. The Botanic Gardens were much improved under his auspices, and the University is indebted to him for an experimental botanical laboratory.

The Islington Grand Theatre.—The recent destruction by fire of this building and its contents has afforded another instance of the perverse unwillingness of men to avail themselves of the protection offered by science. The electric light had, indeed, been partially introduced, *i.e.*, in the *auditorium*, where the danger of fire is under any circumstances infinitesimally small. But behind the scenes, among the flies, and, in short, wherever highly combustible matter was most abundant and the danger greatest, there gas was still supreme. Surely if from any reason there was a difficulty in lighting up the whole theatre electrically, the auditorium is the very part where gas might have been retained with the least risk. A technical contemporary very judiciously recommends that the total banishment of gas from places of amusement should be made one of the fundamental conditions on which a license is granted.

The People's Lecture Scheme.—The London Society for the Extension of University Teaching and the Gilchrist Trustees are trying a very interesting experiment. They are giving short courses of three lectures free, in suitable halls in different parts of London. Such courses have been arranged in ten different districts, and, so far, with marked success. The Town Halls of Bermondsey and Shoreditch, which hold from 1,500 to 2,000 persons, have been well filled—we might say, overfilled. The lectures are on scientific subjects, and are illustrated in the most complete manner by experiments, or by the oxy-hydrogen lantern. There is evidently room for a great extension of this scheme, which will present to large masses of the people the more attractive phases of science, and if it does not in all cases lead them on to systematic study, it will, at least, aid in turning away their thoughts from mischievous and degrading subjects.

Movement of the Earth's Surface.—At the equator, a point on the earth's surface moves rather more than 1,000 miles an hour; in latitude 45 deg. north or south, the rate of motion is about 750 miles an hour. London is carried round the earth's axis at the rate of more than ten miles per minute.

THE NEW CHROMOMICTOR.—I.

A MOST ingenious and very successful instrument for mixing lights of different colours for experiments in physical optics has been devised by Mr. John Aitken, F.R.S.E., of Darroch, Falkirk. The colours produced are very brilliant and beautiful—not of that dull low tone given by the rotation of coloured discs.

The apparatus is shown in the accompanying figures, and consists of a long wooden box, about 30 inches long by 5 inches deep and 5 inches wide. In one end of the box are two round openings, represented in Fig. 1 by the spaces D and E, these openings being placed vertically (RS, GS, VS) to show the coloured glasses (R, G, V) in the lower circular opening; and the shutter S is partly removed to show the clear glass opening D. Each shutter is fixed to the end of a long rod (F), mounted horizontally and free to turn on its axis. Only one of the four rods is shown, passing along the side of the box to the other end, where the lever H is attached. Each lever presses on an index I, fixed to the projecting end of the box. By this arrangement the observer can regulate the amount of the different colours which enter the instrument while he is looking through the eye-pieces (B), only one of which is here represented to prevent confusion in the diagram. These two eye-pieces are fitted into the

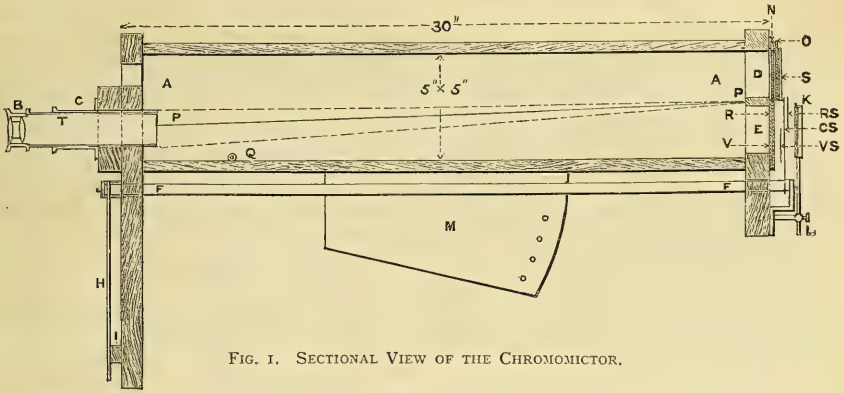


FIG. 1. SECTIONAL VIEW OF THE CHROMOMICTOR.

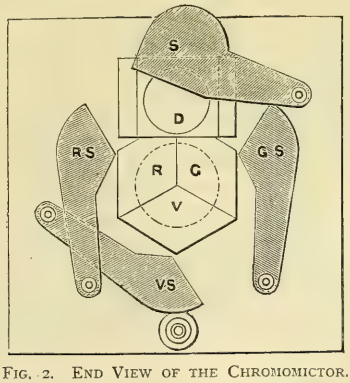


FIG. 2. END VIEW OF THE CHROMOMICTOR.

a short distance apart. The lower opening (E) is about two inches in diameter, and is divided into three equal sectors. Into these divisions are fitted pieces of glass of different colours, to be described in the sequel. The upper opening (D) is a little smaller, and is covered with clear glass. Each sector, as well as the upper opening, is provided with a movable shutter, to regulate the amount of light passing through it. Fig. 2 shows the arrangement of these shutters, this being a vertical transverse presentation of the instrument. They are drawn aside

end of the box opposite the openings, in order that both eyes may be used in the observations. Each of the lenses of the eye-pieces consists of two plano-convex lenses, mounted at one end of a tube, about a foot in length. Each tube slides in a socket (C) fixed in the end of the box. To compare the compound white light with the standard of white light of the correct brilliancy, a horizontal dividing screen (PP) is placed between the two openings (D and E). This screen is fitted horizontally in the box with one end pivotted between the openings,

and the other end movable by means of a lever (not shown). Dividing screens (T) also pass along the eye-piece tubes, coming quite up to the lenses. A round piece of ground glass (K) is held in its position by means of a screw (L), for use when other than sunlight is looked at. The whole instrument is placed on a stand, where an arrangement is made for elevating the front end, to allow of direct skylight being used.

The horizontal movable screen forms an important part. When it is raised the coloured lights fall on the eye-pieces; and when it is lowered the coloured lights are cut off, the white light from the upper opening entering the lenses. When the screen is horizontal, and the coloured sectors are properly adjusted, a perfect match can be made, so as to observe a white disc with a black bar across the middle, the upper half being the pure white skylight through the clear glass, and the lower half being the mixed white light through the regulated coloured glasses. The instrument will combine any colours and show the result of the combination, and any proportions of each colour can be determined by the help of the shutters. It is found that there is an infinite variety of colours which when combined in proper proportions will give white. It is also proved that with red (R), green (G), and violet (V), in the sectors and proportioned by the shutters, all possible colours with their shades and tints can be produced. But by no combination of colours (other than red, green, and violet) can these three colours be produced. These, then, are the primary colours. What would Sir Isaac Newton have thought if he had looked through this instrument, seeing that he considered—half superstitiously—that the seven colours of the rainbow were the primitive colours?

In selecting the colours for the circular opening in the box, the best red is a ruby red glass, dark enough to give only a band in the red when examined with the spectroscope: for green, a glass which passes a narrow band of light in the green of the spectrum, and is about what is known as emerald green; and for violet a glass which passes only the light of the violet end of the spectrum. When the three colours are combined in the proper proportions, so perfect a white can be produced with this chromomictor that it is impossible to distinguish between the standard white and the white produced by the three brilliant colours. To get the perfect match of the two whites, the surface of the interior of the box must be *dead* white; for any polished surface reflection would vitiate the effects. The sun must not shine on the instrument, a bright sky being most suitable. If the red and green shutters be opened and the violet closed, the colour produced is a canary-yellow of considerable brightness and strength.

(*To be continued.*)

FIRE FROM NITRIC ACID.

THERE was recently a prosecution before one of the Prussian courts for danger caused to a train of railway cars. The main question was whether fuming nitric acid could occasion spontaneous ignition—which, after hearing the sworn testimony of the court's expert chemist, Dr. Jeserich, was decided in the affirmative. The agent had sent by railway ten kilos (22 lb.) of fuming nitric acid, the acid being contained in a strong stone jar, tightly closed by a stone stopper and cement. The whole was packed in straw within a wooden case. As, however, such dangerous liquids would not be carried by rail as express freight, the contents of the box were represented to be clothing, and by this means the concealed acid was sent by a passenger train. During the journey the car containing the express freight was discovered to be on fire.

Before the flames had made serious progress, the car was uncoupled and shunted, the fire extinguished with slight damage, and no person was injured. Examination showed that the jar had leaked, and the acid had come in contact with a roll of woollen cloth, whereby the latter was set on fire. Dr. Jeserich gave it as his opinion that all woollen goods, and all hair of animals, horn, etc., have the property of igniting spontaneously when in contact with fuming nitric acid; and he stated that all the explosives, about which there has been so much said and written lately, such as roburite, melanite, etc., depend upon the action of nitric acid on hair and wool.—*All. Vers. Presse, Berlin.*

THE MECHANISM OF THE FLIGHT OF BIRDS.

WE shall here lay before our readers a brief summary of the researches of M. Marey, condensed from the pages of *La Nature*. The author has studied this subject by the aid of "instantaneous" photography. The so-called photographic revolver is capable of taking ten images of a moving body per second. Thus the different postures of a galloping horse or a flying bird can be accurately represented, and points can be observed which utterly escape the human eye. From a comparison of the different species of birds which have come under the observation of M. Marey, he concludes that all execute movements of the same nature In all the wing closes in the act of being raised; on arriving at the highest point of its track, it is suddenly unfolded, and is then depressed, moving forwards, and coming nearer the body. At the end of this downward stroke the joints of the wings fold up again, and the up-stroke re-commences. Figure 1 shows the flight of the crested heron (*Ardea alba*) moving transversely. Figure 2 represents the descending flight of the pelican.

These figures show curious attitudes which the eye has not the time to seize, and with which we have not been rendered familiar by the artistic representations of birds. As it has been justly remarked by M. Maybridge, European artists almost invariably represent flying birds with their wings upraised; the Chinese and Japanese, on the other hand, represent them indifferently with wings elevated or depressed. This does not imply that the artists of the Far East have faithfully reproduced the different attitudes of birds. A comparison of their drawings with those obtained by instantaneous photography shows that the human eye in China, no more than with us, is able to seize actions which are merely momentary.

The representations of a flying bird, if seen from a single point of view, do not give us complete information as to the nature of the movements of the wings. It is necessary to photograph the bird under different aspects to comprehend this mechanism. M. Marey has therefore photographed flying birds from above, when passing horizontally across the field of vision, and when moving in a line towards the object-glass. These images mutually complement each other. Birds seen from above

show a peculiar torsion of the plane of the wing, the existence of which would not be suspected from side-views.

This torsion occurs at the end of the down-stroke of the wing at the moment when the joints begin to fold up preparatory for the up-stroke. Hence there results a screw-like aspect of the wing, recalling the form which

ments of the two wings are perfectly synchronous, though not equal in extent. We see lastly from these images that the body of the bird turns, and leans in different ways, so as to transfer its centre of gravity from one side to the other, according to the requirements of the equilibrium.

Images taken in front show that the extremity of the

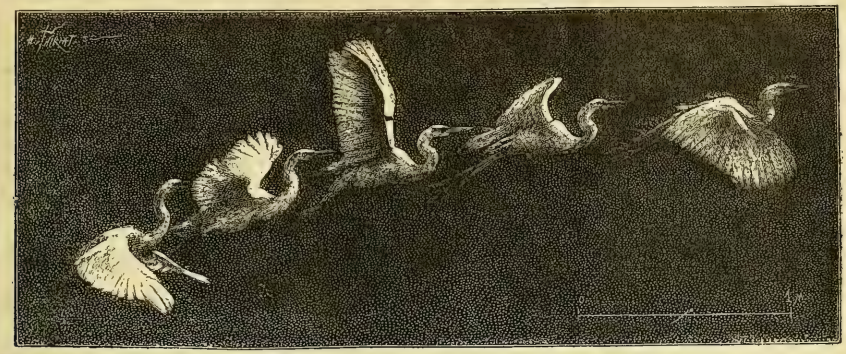


FIG. 1. CRESTED HERON. TRANSVERSE FLIGHT, TEN EXPOSURES A SECOND.

M. Pettigrew regards as the essential cause of the propulsion of birds. We must observe that this shape is produced only at the end of the downward stroke, at the *dead point* of the action of the wing, mechanically speaking, and at the moment when this has come to a rest, and is about to be raised again by the resistance of the air.

These images further show a fact by no means fore-

wing, the really active part of the organ, since it strikes the air with most speed, presents at the moment of the down-stroke changes of plane which are not shared by the secondaries extending from the carpus to the humerus.

It is further useful to know the force which produces the movements of the bird, and to measure the mechani-

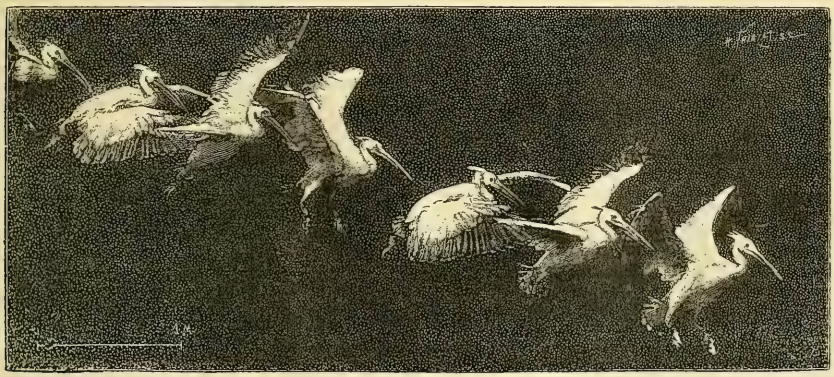


FIG. 2. PELICAN. TRANSVERSE DESCENDING FLIGHT, TEN EXPOSURES A SECOND.

seen—that the acts of flight are not symmetrical. It had been already rightly supposed that a bird which wishes to alter the direction of its flight laterally executes more extended movements on the side which is to progress the more swiftly. That is to say, it gives more amplitude to the movements of the right wing if it wishes to turn to the left and inversely.

It is scarcely necessary to say that photography entirely overthrows the supposition that one of the wings of a bird could beat more frequently than the other. The move-

cal force which it expends in sustaining and transporting itself in the air. Calculations founded on observations show the following values for the forces which act during the flight of the sea-gull.

Vertical component	.. ..	0.623 kilo.
Horizontal „	.. ..	0.898
	Total	1.521 kilo.

These forces are due to the down-stroke of the wings. The up-stroke is passive, due to the pressure of the air

upon the lower surface of the wings, which then sustain the bird aloft after the manner of a kite.

As the resistance of the air under the wings act at a point very remote from the shoulder-joint, and as the pectoral muscles which depress the wings act very near the joint, that is, upon a less advantageous arm of the lever, it results that the effort of the muscles is much greater than the resistance of the air to be overcome.

The effort developed by the pectoral muscles of a sea-gull will be 19 kilos., and as these muscles in section have a surface of 11 square centimetres, the force is 1.6 kilo. per square centimetre.

For the five strokes of the wing which the gull gives per second at the moment when it takes flight the work done is 3.668 kilogrammetres. This value is very high; it is as if a machine should raise its own weight into the air with a speed of more than five metres per second.

But the act of first taking wing is the most laborious phase of flight. It has long been known that birds employ all sorts of artifices to acquire a preliminary speed before beating their wings. Some run along the ground before rising into the air; some take a sudden leap in the direction which they wish to assume when flying. Others allow themselves to drop from an elevated spot with extended wings, or glide through the air at an accelerated speed before moving their wings. All turn their beak to the wind at the moment of taking flight.

It has been observed that many of the larger birds are unable to rise on the wing from any narrow inclosure.

Although the mechanism of the flight of birds is only a very subsidiary point in biology, it is yet worth elucidating. M. Marey's researches afford an interesting proof of the value of photography as a means of scientific investigation.

ANIMAL TANNIN.

IT was formerly held that there was a wide and distinctly marked boundary—a breach of continuity—between the vegetable and animal kingdoms. Modern investigations have, however, overturned one after another the supposed distinctions, and it now becomes a difficult task to find in one of these great groups any feature which is not to be traced in the other also. At one time chlorophyll, the green colouring matter of leaves, was thought to be entirely wanting in animals. But, not to speak of other investigators, in 1879 Mr. P. Geddes presented to the Academy of Sciences a memoir showing the presence and the activity of chlorophyll in the green *Planariæ*. These animals, on exposure to sunshine, decompose carbonic acid, just like the green leaves of plants, and give off bubbles of a gas containing more than double the proportion of oxygen found in atmospheric air.

Another principle very widely diffused in the vegetable world, and supposed to be entirely absent in animals, is tannin. This substance has attracted the attention of mankind from a very early date, on account of its property of converting animal skins into leather. Another of its common uses has been in the manufacture of ink. Decoctions of gall-nuts and of other vegetable matter rich in tannin give an intense blue-black, or in some case a greenish or brownish black colour, if brought in contact with solutions of iron, such as copperas or "green vitriol" (ferrous sulphate), certain compounds of chrome and other metallic salts.

Now, M. Villon, of Lyon, has for a long time been engaged in searching for tannin formed in the organism of an animal. He seems to have taken up this inquiry from the fact that as far back as 1810, M. Penaut, a pharmaceutical chemist of Bourges, found in the bodies of corn-weevils gallic acid, a kindred compound. Villon, having a large quantity of these insects (*Calandra granaria*, a beetle of the Curculionide family, too well known for its ravages in granaries), set to work to examine them very carefully for tannin. There is no occasion for us to describe the process which he followed, which could be of interest only to the professional chemist. It may suffice to say, that from 500 lbs. of weevils, he obtained 15 lbs. of tannin, which he proved to be really such, not merely by analysis, but by its action upon animal skins and metallic salts, especially those of iron. This form of tannin he designates by the rather long-winded name of "fracticorni-tannic acid," and he even thinks that it might be rendered practically useful in tanning, dyeing, ink-making, and in pharmacy. It would indeed be a happy thought to obtain in this manner partial compensation for the damage occasioned by the weevils.

About the same time Mr. J. W. Slater, F.E.S., whilst engaged in studying the generation of colouring matters in the bodies of insects, was struck by the fact that a very large proportion of insects, especially beetles which prey on wood, bark, roots, etc., display colours closely resembling those yielded by tannin and its modifications in contact with animal matter. He, therefore, took the elytra (wing-cases) of some cock-chafers, and having freed them from fatty matters, he steeped them in solutions of iron, chrome, and copper. The changes of colour produced were exactly those which would happen if a slip of tanned leather or other matter impregnated with tannin were similarly treated.

As in these experiments he used not the entire bodies of the insects, but merely their outward integuments, the objection is forestalled that the tannin thus detected is derived from remnants of vegetable matter present in their digestive organs. It must, however, be admitted that with purely carnivorous insects Mr. Slater was not able to obtain any similar results.

The importance of this discovery, made simultaneously by two independent observers, is that it confirms what may be called the chemical continuity of the animal and vegetable kingdoms. It shows also to what an extent tannin ranks as a colour-former in the organic world. Botanists have not failed to show to what an extent the autumnal tints of leaves are due to the changes which tannin undergoes on exposure to air and light. These tints are the most splendid in the case of trees and shrubs rich in tannin, and in such species we often notice that a leaf or a part of a leaf accidentally screened from light retains its green summer-colour, whilst those around have turned of a rich yellow, red, or brown.

And now, also, we see the same classes of colours in insects—stone-colours, drabs, fawns, yellows, etc.—traced to the same principle.

CLEANING BRASS.—It is a great mistake to clean brass articles with acid, as they very soon become dull after such treatment. Sweet oil and putty powder, followed by soap and water, is one of the best mediums for brightening brass and copper. To frost brass-work, and give it an ornamental finish, boil the article in caustic potash, rinse in clean water and dip in nitric acid till all oxide is removed; then wash quickly, dry in boxwood sawdust, and lacquer while warm.

GENERAL NOTES.

Fall of a Meteorite.—A meteoric stone, said to be of exceptional magnitude, is reported to have recently fallen not far from Tayninh, a place situate about 125 kilometres from Saigou (Cambodia).

African Indigo.—It is probable that the cultivation of indigo will be undertaken on a large scale at Sierra Leone. The plant grows there wild, and is said to flourish more luxuriantly than in Bengal.

New Theory of Odours.—M. P. Leclerc maintains that odour is, like light and sound, a phenomenon of undulation. He considers that he has obtained interference of odours, analogous to the interference phenomena of light.

The Fermentation of Glycerine.—M. E. C. Morin has shown in the *Comptes Rendus* that when glycerine ferments under the influence of *Bacillus butylicus*, the products are ethylic, propylic, butylic, and amylic alcohols, all of them normal.

Absence of Microbia in Air expired by Animals.—MM. J. Strauss and W. Dubreuilh (*Comptes Rendus*) prove that the respiration of men or other animals in a limited space *purifies* the air, as far as "germs" or microbia are concerned, though polluting it in other respects.

The Velocity of Tornadoes.—According to Prof. Mees (American Association), bits of straw and hay are driven into deal boards, and even into the dense bark of the hickory tree. Experiment shows that to produce such results velocities of from 150 to 175 miles per hour are needed.

Neosote.—This new preservative, similar in its properties to creosote, is prepared by boiling the tars condensed from blast furnaces with caustic soda. The sodium phenols thus obtained are purified and then form a liquid less caustic than carbolic acid, although it is said to be equal to it in its antiseptic and disinfectant qualities.

Polydactylism in Man.—Dr. C. H. H. Spronck, in the *Archives Néerlandaises*, gives an account of a man who had on his left hand two thumbs and four normal fingers. It is not generally known that in man, as in all the mammalia, the typical number of digits is seven. Cases where the number of fingers exceeds seven are not diseases, but, as Darwin contends, reversion to a primitive ancestral type.

Strength of Heated Iron.—From experiments made by Professor Wood, of the Stevens Institute, it appears that if iron be stretched while hot there is a slight diminution of its strength, but when the stress does not exceed one quarter of the ultimate strength, the loss is only about 1½ per cent. He finds that unless there is a perceptible elongation while the metal is hot, the iron is not weakened by the treatment.

Mr. Norman Lockyer's Theory of Meteorites.—In a memoir communicated to the Academy of Sciences we read:—"The celebrated meteorite of Pallas cannot be the product of reactions of the nature of fusion. Its structure necessarily pre-supposes the anterior existence of a voluminous and complicated total, of which it once formed a part. It comprises, with a very regular structure, minerals so unequally fusible that the application of heat would disorganise it as surely as it would disorganise an animal or a plant."

Desmazure's Accumulator.—In the new accumulator which was used on the electric launch tried at Havre, the electrodes consisted of plates of amalgamated zinc and porous copper, the latter being produced by the consolidation of powdered copper under very great hydraulic pressure. The zinc plates formed the negative electrode, and were in metallic connection with the box, which was also of zinc, whilst the positive plates were placed in vegetable parchment bags and suspended. Contact with the negative plates was prevented by glass rods. The electrolyte was a mixture of chlorate of sodium and a caustic solution of zinc oxide.

New Magnesium Lamp.—It is said M. F. Leclercq, of Paris, is about to bring out a new magnesium lamp, intended to replace the cumbersome and uncertain lamp hitherto in use. In the old lamp there were two magnesium tapes fed by clockwork, which had to be rewound at frequent intervals. In the new arrangement there is only one tape, and it is claimed that the lamp will burn without adjustment for twenty-seven hours. Great improvements have also been made in the manufacture of magnesium, by which the cost of production has been considerably reduced.

Nickel Plating.—A new process of nickel plating has recently come into use in Belgium, by which a thick plating of nickel may be deposited on any metal by a feeble electric current in a very short space of time. The bath is composed of 10 parts sulphate of nickel, 7¼ of neutral tartrate of ammonia, 0·5 parts tannic acid, and 20 parts of water. The sulphate of nickel is dissolved in 3 to 4 parts of water, carefully neutralised, the other ingredients added, and the solution boiled for a quarter of an hour; the rest of the water is added, and the liquid filtered or decanted. By adding the materials in the same proportion the strength of the bath may be kept constant. It is said that the deposit is brilliantly white, soft, and homogeneous, and has, even when of great thickness, no tendency to scale.

Utilisation of Slate Waste.—Much has already been accomplished in the utilisation of basic slags from the steel and iron works, and we are very pleased to add that experiments have shown that what has hitherto been called "waste" in slate quarries, can be manufactured into bricks and tiles. We learn that in Italy this new departure has already met with considerable success. There is, in fact, no such thing as "waste" in Nature and the sooner we recognise this in all branches of manufacture the better. What is left as a by-product may not be useful in a particular process, although it is still matter susceptible of conversion into a useful product for other purposes, if only the correct treatment can be discovered; the desideratum in all cases being to find the simplest and cheapest form of conversion.

New Use for Salt.—According to the *American Architect*, the addition of salt to cement mortar in cold weather preserves it from the bad effects of freezing. The reason for this is not quite clear, as frozen water, whether it be fresh or salt, expands to the same extent; but it is said that engineers and others who have tried it are unanimous in their opinion of its value. In many cases masonry has been laid in cement in cold weather, a considerable proportion of salt being used in the mixture. After repeated freezings and thawings it has remained in perfect condition, while work near by laid in mortar of the same kind, but without salt, has been disintegrated by frost. We should imagine, however, that dwellings constructed with salted mortar would probably be damp, owing to the property salt has of absorbing water.

An Electrical Dynamometer.—A German electrical engineer, Herr Zacharias, has devised an apparatus, which is made by Messrs. Siemens and Halske, for automatically recording the pressure in the mains of an electric supply system. The instrument consists of an ordinary pendulum clock, which every forty-five seconds closes an electric contact, throwing an electro-magnet into circuit. The armature of this magnet is opposed by a spring of such a strength that when the pressure in the main is 120 volts, it occupies a definite position. If the pressure increases or diminishes, the armature occupies positions to either side of the normals. In front of the armature a cylinder revolves slowly, carrying a paper strip with a line drawn in the normal position. When the contact is made, a second electro-magnet forces this cylinder against a pin upon the armature of the first magnet, and by the repetition of this action every forty-five seconds a practically continuous record of the pressure can be obtained.

Earthquakes:—Mr. P. Malet, writing to the *Morning Post*, combats the theory that earthquakes are always dependent on volcanic action, but originate frequently from submarine landslips. Mr. W. Foster, the electrician of the Eastern Telegraph Company, points out that soundings in the Mediterranean show mushroom-shaped mountain ranges, abrupt and precipitous table-lands, immense marginal shelves and over-hanging cliffs. Tottering masses are close to precipices 5,000 feet deep, and the action of water causes them to slide over. There are instances of a difference of depth between the bow and stern soundings of a ship from 300 to 12,000 feet. Near Japan, on the coast of South America and in the Mediterranean, earthquakes occur from these changes near the shores. Sometimes disturbances take place in mid-ocean, as proved by ocean waves. Hence many earthquakes are the result of subsidence. We may add that this theory agrees well with the observed fact that in deep mines no earthquake shocks have ever been observed.

The Lake of Geneva.—It has often been asked how long it would take to re-fill the lake of Geneva (Lake Leman) if it were emptied. The views expressed on this question are so varied—one wiseacre having affirmed that it would take the Rhone only a fortnight to fill the lake, whilst another has put it down at one year—that an estimate just made, based upon what appears to be a sound calculation, is greatly interesting, especially as the result obtained will be a surprise to many. The lake of Geneva covers an area of 577,860,000 square metres (223 square miles). Its greatest depth is 312 metres (nearly 1,024 feet), and its average depth may therefore be assumed to be 150 metres (nearly 490 feet). In accordance with this supposition, the lake contains ninety milliards of cubic metres (close upon 20,000 milliards of gallons) of water. The average inflow from the Rhone per second is 27 cubic metres (5,943 gallons) or 2,332,800 cubic metres (513,425,972 gallons) in the twenty-four hours. To fill the basin of the lake, therefore, the Rhone would require—one hundred and six years.—*Iron.*

New Uses for Tar.—The coating of brick and wooden structures with coal tar, as a rough and ready means of preserving them from the action of damp, has been common from the earliest days of the gas industry. It has also been usual in chemical works to protect the stones used in the construction of acid tanks, etc., by a preliminary soaking in heated tar. But the great improvement in strength and impermeability to moisture which results from the simple operation of boiling bricks and stones in gas tar is certainly not so generally known as it should be. Professor Lunge, in the new edition of his work, "Coal Tar and Ammonia," draws attention to the subject, and indicates several useful applications. He points out that drain and roofing tiles, which are quite porous and brittle as they leave the kiln, may be rendered absolutely water tight and much stronger by immersion in a bath of hot tar. Building stones are also greatly improved by similar treatment; and for many purposes the dead black colour which results is an advantage rather than an objection. The tar should be deprived of water and its most volatile oils; and to produce good results the bath must be maintained at a temperature of at least 100° C. The articles to be treated should be thoroughly dried, and allowed to remain in the tar for some time.—*Industries.*

The Nearest Star.—The distances of the stars are ascertained in the same manner as those of the sun and planets—that is, by parallax. Instead, however, of taking two stations at different parts of the earth's surface, and laying down a base line between them, we take the diameter of the earth's orbit, or 183,000,000 miles, as the base, the observations being taken at intervals of six months. Even with this immense line, however, the parallax is so small that it can only be detected by the most careful observations and accurate instruments. In no case has it been found to be greater than 1″; and if this be its value, the distance of the star must be 206,000 times as great as that of the sun. The parallax of about a dozen stars has now been ascertained, and is found to vary between 0·919″ and 0·046″. The star *a* Centauri is the nearest to the earth, and its distance is estimated at 20,496,000,000,000, or more than 20 billions of miles; while the average distance of stars of the first magnitude is probably three or four times as great as this. These figures, however, fail to convey to the mind any definite idea as to the real distance; perhaps the best mode of expressing it is by stating that light, with its speed of 184,000 miles a second, takes $3\frac{1}{2}$ years to travel from that star to us; while the smaller telescopic stars are so remote that it must require upwards of 5,000 years for their light to reach us.—*Cassell's Popular Educator.*

HOUSEHOLD EXPERIMENTS ON HEAT.

THE handle of a flat-iron, though protected from the fire by the flat smoothing surface, soon becomes too hot to be touched by the fingers, the reason for this being that the heat taken up by the flat surface of the iron is conducted through the metal to the handle. In the case of a soldering iron the metallic portion is mounted in a wooden handle, which can be touched with impunity even when the tool is so hot that the part of the wood in contact with the metal is actually scorching. Why should there be this difference between the behaviour of the handle of the iron and the handle of the soldering tool? The answer is simply that the iron is a better conductor of heat than wood. Another very simple method of showing the difference between a good and a bad conductor is shown in our illustration, taken from a recent number of *La Nature*. A penholder with a metallic barrel is taken, and a piece of paper is bound round it so as to be partly over the wood and partly over the metal. If this be then cautiously heated over a spirit lamp, the paper round the wood will be scorched, while that round the barrel will not be discoloured. The metallic barrel conducts the heat away so quickly that the temperature of the paper over it does not rise enough for it to be scorched.

EXPERIMENT TO ILLUSTRATE THE CONDUCTION OF HEAT.

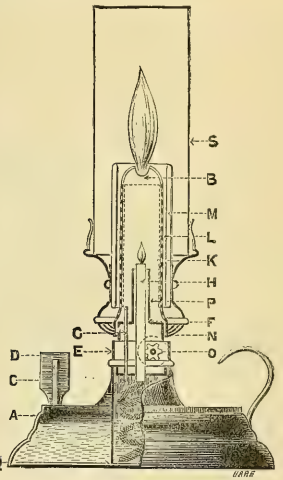
The action of the gauze in the safety lamp used by miners is somewhat analogous to the effect of the metallic barrel, the temperature of any gaseous mixture burning inside the lamp being reduced by the conduction below the igniting point of the mixture, so that until the gauze itself becomes red hot the miner is safe. Again, in tea and coffee-pots the non-conducting property of wood or ivory is taken advantage of by the insertion of small plates of these or other non-conducting materials between the pot and the handle, and even in some cases by making the handles themselves of bad conductors.

VINE FUNGUS.—An additional pest, *Coniothyrium diplodiella*, has attacked the vines in the south of France, causing the grapes to shrivel and dry up. The enemy is a fungus.

THE PETROLEUM GAS CANDLE.

THIS ingenious and safe lamp, burning petroleum vapour, was invented by Mr. Chandor, whose name is well known in connection with the early history of the American petroleum industry.

The lamp has the form of a bedroom candlestick, the lower part forming the reservoir for the oil. This has a peculiar construction; in the centre is a hollow metal cylinder soldered at the top to the outside part of the reservoir, which extends nearly to the bottom of the oil receptacle, leaving only a space Q, about the thirty-second of an inch high, between them. The reservoir is filled by pouring the oil into this cylinder, the displaced air finding its exit by the tube C, which is protected from a light by the match-box plate D.



CHANDOR'S PETROLEUM GAS CANDLE.

The burner is composed of two portions; the inner part screws into the top of the cylinder, and carries the wick tube H and ratchet O for moving the wick. The wick tube is surrounded by an outer tube P, communicating with the air by an opening at E. To prevent any risk of explosion, the tube G passing from the cylinder to near the burner is provided, so that should the oil by any chance become warmed its vapour is led away to the flame.

Fitting very tightly to the burner, so as to make a nearly air-tight joint, is the outer burner, consisting of an inner cylinder of wire gauze K, surrounded by a perforated cylinder L, which is bent over at the top, forming the burner B. An opalescent tube M is fitted outside this cylinder, giving to the whole the appearance of a candle. To protect the flame from currents of air it is surrounded by a glass shade S.

In using this lamp the external burner is removed and the little wick lighted, which then burns with a small flame like that given by a benzoline lamp. When the outer burner is placed over this, a stream of smoke issues from the opening at B, as the supply of air passing through the small aperture E is insufficient for the complete combustion of the oil. On applying a light, the vapour ignites, and, as soon as the shade becomes warm, burns

with a steady flame; the air supply for the complete combustion being drawn through the openings at F and N.

This lamp is eminently portable, is very free from smoke and smell, and ought, at once, to supersede the dangerous benzoline lamps. The manufacturers, Messrs. Nolting, of Mark Lane, do not claim that it is better than the ordinary forms of lamp, but only that it is a safe portable light. From photometric experiments it has been found that these lamps give a light equal to one and three-tenth standard candles, and that the consumption of oil is half an ounce an hour, so that, with oil at eightpence the gallon, the cost for eight hours is only one farthing.

A LARGE METEORITE.

A LARGE mass of meteoric iron has lately been discovered in the state of Wisconsin. It was ploughed up three years ago in a cornfield, and attracted attention from its weight and silvery lustre. The farmer supposed it to contain silver, but he was quite ignorant of its true nature. Accordingly it lay about his farmyard, until lately an acute observer saw what it really was. When it was ploughed up, during the excitement about iron ores in the neighbourhood of the field, a speculator chanced to see the large mass and at once paid £11 for an option on the forty acres to search for iron ore. The mass was sent to Professor Fisher for analysis. On its being discovered to be a meteorite, the owner claimed the curiosity; but the professor was so struck by the size of the mass that he went to the farm to make investigations. He found that it had been struck by the plough near the surface of the ground, in a field that had been cultivated for corn for several successive years; and the farmer was quite certain that it could not have been there the year before (1883). The fresh, silvery appearance of the mass testified to the probability of its having recently fallen. It is, however, quite remarkable that it kept so bright during the three years it lay in the farmer's yard. No similar pieces have been seen, nor does this show signs of fracture. The mass has been considerably disfigured by attempts to chisel off pieces, and one piece was forged into a spike. When it reached the professor's hands, after the pieces had been chopped off, it weighed 53lbs. It is of irregular shape, 8 by 8 inches across the face, and 7 inches through in the thicker part, but with an average thickness of 4 to 5 inches. The reverse side is nearly flat, and pretty uniformly covered with circular juttings. It presents the ordinary appearance of most masses of meteoric iron, the surface crust having entirely disappeared. It seems probable that it lay with this surface in contact with the ground during the three years after it was dug up, and the crust disappeared by the ordinary process of weathering. The front side is less regular in shape, and shows several large depressions. It is largely covered with the fused crust which is heaped up in ridges, and shows all the peculiarities of the lines of flow characteristic of irons which have been picked up immediately after their fall. The character of this St. Croix meteorite, as it is called, independent of the confirmatory evidence afforded by the circumstance of its history, would make it probable that its fall did not precede by many months the date of its being ploughed up. It contains 90 per cent. of iron, 7½ of nickel, 1¼ of cobalt, ½ of phosphorus, ½ of silica, with traces of carbon, copper, and tin. Where did this come from?

DUST TRAPS.

SOME cupboards and drawers seem to have the power of attracting dust. A little consideration will show that there is sufficient reason for expecting that dust will accumulate in such places. Dust is carried about only when the air is in motion, and it begins to settle as soon as the motion ceases. It will naturally settle on any ledges or the edge of cracks. How does it get driven through the cracks or narrow spaces round the doors? A difference of one inch in the height of the barometer is due to a difference of pressure of about one-thirtieth, and since the volume varies inversely as the pressure, the volume will vary by about one-thirtieth. A cupboard measuring 4 feet by 4 feet by 2 feet, will contain about 30 cubic feet of air, allowing for shelves. If it is closed when the barometer is low, and a rise of one inch should take place, in order that equilibrium may be restored, about one cubic foot of air will have to find its way into the cupboard. The pressure with which it will be forced in will at first be about half a pound to the square inch, or 72 pounds to the square foot. A difference of 15 degrees of temperature will produce the same result, and it may happen that the two causes may act at the same time. Unless very considerable care is taken in fitting the doors, it is probable that equilibrium will soon be restored, and any dust that has settled on the ledges will be drawn in; as soon as it is inside, the air being still, it will settle, and will not be ready to be blown out at the next change. The pressure within the cupboard will be reduced every time the door is opened, the door acting like a piston. This is likely to draw in any dust that is lying near. Cabinets for specimens, etc., should be arranged with flaps or guards to every ledge or crevice, taking care that they do not act as receptacles for dust in themselves.

The best remedy, however, has been devised by an American curator, who provides each cupboard or drawer with a dust trap. This consists of a large hole at the back, covered both inside and outside with a piece of wire gauze, and the space between, corresponding to the thickness of the board, is filled with cotton wool. At any change of pressure, due either to natural meteorological causes, or to the opening and shutting of doors, will produce a displacement of air in this hole. The air meets with scarcely perceptible resistance, all dust lying on the wire gauze is stopped by the cotton, and the result is perfect absence of dust.

THE LARGEST BRILLIANT IN THE WORLD.—Concerning the early history of this South African gem very little is known; in fact, where the stone was found is only a matter of conjecture. It is, however, believed that it was found in one of the Kimberley mines, South Africa. It was decided to cut it into the largest possible brilliant, still preserving a good shape. The stone in its finished condition weighs 180 carats, is a beautiful, perfect steel-blue diamond, and is the largest brilliant in the world. It is 39.5 mm. (1 9-16 inches) long, 30 mm. (1 11-64 inches) wide, and 23 mm. (15-16 of an inch) thick, being exceeded in size by one diamond only, the Orloff, belonging to the Russian crown, which weighs 194¾ carats, but is a large deep rose and not a brilliant. The Victoria exceeds the Regent in weight by 44½ carats. The Kohinoor weighs only 106 1-16 carats. The original weight of the stone was 457½ carats, 3 1-60 ounces troy.

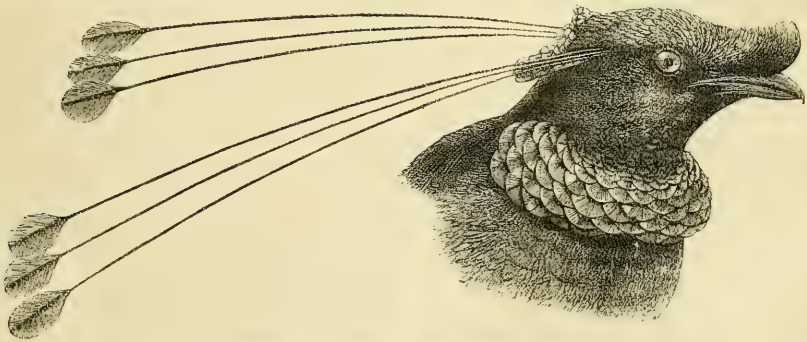
NATURAL HISTORY.

BIRDS OF PARADISE.

Wilson's Bird of Paradise (*Diphyllodes Wilsoni*), shown in Fig. 1, is the smallest of all the birds of paradise. Behind the head a ruff of canary-coloured feathers stands erect above the scarlet back and wings. The breast is covered by a shield of glossy green plumes, which toward the throat are marked with metallic green-violets pots of extraordinary brilliancy. The two centre feathers of the tail, prolonged for five or six inches beyond the others, cross each other, and are curved into a complete circle of bright steely purple.

Wilson's Bird of Paradise (*Diphyllodes Wilsoni*).

But the chief peculiarity of the bird is in the head, which is bald from the vertex backward, the bare skin being of



Six-plumed Bird of Paradise (*Parotia Sexpennis*).

the brightest imaginable cobalt blue. The bizarre effect thus produced is still further heightened by two fine lines of feathers which, running lengthways and from side to side, form a dark cross upon the brilliant azure background. The plumage of the hen bird is of a sober brown, as is the case with the females of all the *Paradeisidæ*, but, like the male, the bare head is blue, although not nearly of so bright a colour. This bird is a native of Batanta and Waigiou Islands, frequenting trees of no great height at an altitude of seven to eight hundred feet above the sea. The paradise birds attract attention less by the brilliancy of their plumage than by its extraordinary development. From the Arfak range there are several species, which at a little distance look like a uniform black. Two of these, *Lophorhina* and *Parotia*, are furnished with appendages which are, perhaps, as striking as any with which long ages of selection have provided the birds of this group, but until the specimen is taken up in the hand they will pass unnoticed. In the former an immense plume of feathers springs from the occipital region, and reaches to the end of the tail. It is of the deepest velvety black, shot in some lights with steely-green reflections, and with the outermost feathers slightly recurved toward the tip. The top of the head is covered with scale-like feathers of metallic green, and a shield of the same colour and nature, but of a still brighter shade, adorns the breast. The rest of the body is dull black. Any further ornament or colour would be out of place, and one feels that this splendid creature fully deserves its appellation of the "superb" bird of paradise. Almost more beautiful still is *Parotia sexpennis*, the six-shafted bird of paradise, which Signor D'Albertis was the first European to observe in its native jungle. The curious plumes which give the bird its specific name lie so close to the neck in the dried skin as to be almost invisible. They consist of three slender filaments (shown in Fig. 2), springing from each side of the head, and terminated by a spatulate expansion. A bar of vivid steely green across the vertex, and a peculiar puff of metallic silver at the base of the beak—a colour which is believed to be unique in the bird world—completes the head decoration. Like *Lophorhina*, the rest of the plumage is almost entirely black, except at the upper part of the breast, which is furnished with a collar of green and bronze feathers. The tuft of silvery feathers on the forehead can be either erected, as represented in the engraving, or depressed flat against the skull, where it forms a triangle of regular shape, with the apex forward.—*The Cruise of the "Marchesa." Dr. F. H. H. Guillemard.*

Feeding Grounds of the Herring and Salmon.—At the Granton Literary Society, Dr. John Murray recently lectured on the above subject, and said that Loch Fyne had been studied with some detail during the last two or three years, and an abundance of crustaceous animals had been found living on the bottom and three or four fathoms above it. Previous to this investigation, some of these creatures were unknown in British waters or were very rare. Such, for instance, was a copepod (*Euchaeta*) and a shrimp-like animal (*Nyctiphanes*). The adult forms of these animals had been found in great numbers at the bottom of the loch throughout the year. Their young were frequently carried by currents to the surface, and had been frequently thrown upon the shore in immense quantities, but the adults were unknown, though it is now known that they exist in large quantities. In addition to these animals, enormous numbers of shrimps and prawns of ordinary kinds, but of a brilliant red colour, were also found. At similar depths in Loch Etive, Lochiel, Loch Duich, and Loch Carron, animals of the same kind were found, although the species varied in different lochs. A genus (*Conchœcia*) never known previously to inhabit the waters of these coasts, abounded in Loch Etive. The predominant form in Lochiel was a beautiful pellucid shrimp-like animal (*Phasiphœ*), while another form of the same creature (*Borophausia*) predominated in Loch Duich. Towards the coasts of Norway and in the Faroe channel they found the same kinds of animals living near the bottom in depths from 100 to 600 fathoms, and at these depths the common ling, sand eels, thorsk, cod, dog-fish, and skate had been found, some of them descending as deep as 500 fathoms, while at depths of two miles species of the cod, salmon, and eel families were discovered. All these fishes, except the thorsk, were also found at the bottom of Loch Fyne, and in some instances the remains of herrings had been found in their stomachs.

Mice as Butter-Testers.—Mr. L. W. M'Coy, of Princeton, New Jersey, tells a curious story, from which it would seem that the mice in his laboratory possess the valuable power of distinguishing between oleomargarine and butter, and show a very decided preference for the latter article. He states that some time ago he received for analysis several samples of butters whose genuineness was questioned. The dishes in which the butters, preparatory to analysis, were melted, were, after the fat had been roughly poured off, permitted to remain overnight on one of his working tables. The next morning he was surprised to find that ten of the twelve dishes had been licked clean by mice, while two had been left untouched. His analyses finished, it turned out that all the suspected samples were pure butter with the exception of two, and, upon inspection, he discovered that these two were the very fats the mice refused to eat. It seemed hardly possible that this could be due to mere chance, so Mr. M'Coy spread out in a clock-glass some butter, and in another and similar glass some oleomargarine. The glasses were placed alongside each other on his table, and allowed to remain over-night. Next day he found the glass which had contained the butter polished as clean as though it had been well washed, whereas the one charged with oleomargarine was to all intents and purposes intact. The mice had merely nibbled at it. He next set out four glasses, two containing butter and two oleomargarine. The result in this case was also conclusive. The mice dined on the two butters and completely ignored the oleos. The oleo in one glass was untouched, and that in the other merely bore the footprints of a mouse. When no butter, but simply a glass of oleo was left on the table, the mice partook thereof, but only in small quantities. There is no doubt that a hungry mouse will eat oleo, but it seems that it will do so only on condition that there is no butter to be had.

Elephants at Work in Rangoon.—Lazy and clumsy-looking as the elephant appears in our menageries, where it is merely an object of curiosity, in Asia it is as useful an animal as the horse, and is, indeed, employed in a greater variety of ways. There are few, if any tasks which a horse can be trusted to perform without careful and constant guidance, whereas the elephant is frequently given as much independence of action as a

man would have for the same work. This is notably the case in the woodyards of Rangoon and Maulmein, where the entire operation of moving and piling the heavy timber is performed by male elephants without any special supervision by the keepers. The logs to be moved are teak-wood, which is very heavy. They are cut into lengths of twenty feet, with a diameter, or perhaps a square, of about a foot. An elephant will go to a log, kneel down, thrust his tusks under the middle of it, curl his trunk over it, test it to see that it is evenly balanced, and then rise with it and easily carry it to the pile which is being made. Placing the log carefully on the pile in its proper place, the sagacious animal will step back a few paces and measure with his eye to determine whether or not the log needs pushing one way or another. It will make any necessary alteration of position. In this way, without a word of command from its mahout, or driver, it will go on with its work.

Oyster Culture.—Some remarkable statistics showing the progress of the oyster trade in France have just been published. It appears from them that during the past twelvemonth the beds have produced no fewer than 600 millions of oysters, or ten times more than in 1876. The progress does not concern quantity alone; the quality also shows an equally noteworthy improvement. In 1883 France exported 31 millions, this year the exportation will not be less than 50 millions. The culture of what is known as the Portuguese "naissain" has been eminently successful in France. Formerly France imported great quantities of them: for example, in 1883 she imported 154,647 kilogrammes, representing a value of nearly 2,000,000f. Instead of importing, she now exports them; thus for the present year the exports of Portuguese oysters amount to over 500,000 kilogrammes.

Monkeys and Oysters.—According to a contemporary, Mr. A. Carpenter, of Bombay, has observed Macacus monkeys, on an island off South Burmah, opening oysters with a stone. They bring the stones from high-water mark down to low-water, selecting such as they can easily grasp. They effect the opening by striking a piece of the upper valve until it dislodges and is broken up. Then they extract the oyster with finger and thumb, occasionally putting their mouth straight to the broken shell. The way they have selected is the easiest method of opening the shell.

New Scientific Expedition.—A scientific expedition has been despatched to the South Pacific by the United States Government. The cruise of the Fish Commission steamer *Albatross* is to last three years, and we may be certain that the dredging will add many species of fish to our collections and clear up some mysteries in biological science. This (says a contemporary) is by no means the first expedition of the kind undertaken by America. Professor Agassiz about fourteen years ago made a voyage in a specially equipped Government vessel of war all round the Gulf of Mexico and the east and west coasts of South America, and up the North American coast as far as Puget Sound. The dredge yielded prizes in the shape of specimens almost at every haul.

Capture of Great Northern Divers.—H. M. E., writing in *Land and Water*, records the capture of two great northern divers off Penzance, during the last three weeks.

WILL-O'-THE-WISP.—II.

(*Continued from p.* 14)

A VERY full account of the appearance of an *ignis fatuus* is to be met with in "Cameos from the Silver Land," by E. W. White, F.Z.S. Some passages of his narrative I quote. The inhabitants of Stapua, a small town in the La Plata States, situate on the Parana, were, during the author's stay, alarmed by "a mysterious light that appeared almost every night in the second plaza, situate on the high river banks, but where—although the ground was in some parts a temporary swamp, from the rains settling in the hollows—were posted the line soldier's barracks; and to the guard bivouacking round their fire at night it first manifested itself. My friend, Lieut. Morcillo, the officer in command, soon got to hear of it, and scenting trickery, issued notice that he had given his soldiers orders to fire upon it whenever and wherever it became visible. Singular to relate, no sooner did the light burst forth than it was heralded throughout the town by a universal chorus of howls from all the mangy curs in Stapua. In order to elucidate the mystery, Lieut. Morcillo and myself visited the plaza for several nights in succession, accompanied by three or four soldiers with loaded rifles and ourselves armed with revolvers. The military were posted round the square, and we waited from ten o'clock till twelve or one in an atmosphere bathed with the brilliancy of a full moon. Only twice it was seen by me, but then very distinctly; the first time some little distance off, but the second quite close. On the first occasion the light started up from the ground with the brilliancy and speed of a rocket, and then again descended to the earth with equal velocity but less splendour; on the second we caught sight of it as it directly but gently approached along the road, upon which, running to intercept it, and stumbling at every step over rough and swampy ground we managed to arrive within three yards of the glowing vision, as it slowly glided on at a level of about five feet from the earth. It presented a globular form of bluish light, so intense that we could scarcely look at it, but emitted no rays and cast no shadows; and when about actually to grasp the incandescent nothingness, suddenly elongating into a pear-shape tapering to the ground, it vanished, but on looking round up it rose again within fifty yards, but this time we could not overtake it, as it bounded over a hedge, then over trees, and finally disappeared in an impenetrable swamp. According to the testimony of the soldiers, on another occasion they beheld it rise from the swamp and perch for some minutes on the top of the roof of a neighbouring ranch without walls, after which it pierced the roof and subsided in the ground beneath; in our case there was no deception, and moreover we noticed that it never appeared on a windy night nor after rain." Mr. White adds, in comment: "Although the marsh-gas theory presented itself to my unwilling mind, it would have to be strained considerably to account for all the circumstances."

We will now attempt an examination of the hypotheses proposed for the explanation of the wisp.

Trickery may be at once set aside as out of the question. The movement of the light is totally unlike that of a man carrying a lamp. It is at times much swifter, overleaping objects which a man could not surmount, and playing over water, and at heights of from twenty to fifty feet in the air, and where there are no solid objects from which a light could be thrown back if projected, *e.g.*, by means of a dark lantern; neither can

we consider that it is produced by the reflection of a light thrown from some neighbouring house, since the wisp generally appears far away from houses. Fireworks are an extremely improbable agency. Not to speak of the slowly progressive movements of the wisp sometimes observed, it is in the highest degree unlikely that any practical joker would convey a quantity of pyrotechnic appliances by night into lonesome moorlands, woods, and peat-bogs on the slender chance of being able to startle some stray traveller.

(*To be continued.*)

THE TIME IT TAKES TO THINK.

MEN in all ages have been familiar with the fact that thought is habitually more active and more speedy in the case of some persons than of others. Whether in the exercise of the imaginative or the reasoning faculty, or in the action of that guiding purpose of life which we call the will, the general truth of this observation has been always evident. As we come to a higher stage in human development, with its corresponding increase of intelligence, it is not remarkable that the mind should seek to subject itself to a closer scrutiny, and to catalogue more exactly the results of its introspection. This has happened with regard to the question before us. In particular has the period which intervenes between the impact of impressions from without and the visible response of the will in muscular action or other mode of expression become of late years a subject of careful investigation. Since the first quarter of the present century, when the comparative speed of visual observation, was chronicled in the case of the astronomers Bessel and Struve, the varying rate at which the mind responds to the numerous impulses which reach it from the outer world has been measured with some exactitude. Most of our readers are familiar with the term "reaction" period. They will recognise it as expressive of the whole interval between the action of a stimulus, of whatever kind, and the visible response of the individual affected by it. They will also perceive in the period of "reduced reaction" that interval shortened by the space of time allotted by experimental precision to the transit of purely sensory and motor impulses—the period, namely, which changes the one into the other, and represents in the mind the average time required to think and to will. Discoveries not now very recent have taught us that the ordinary duration of this period is, in the case of simple impressions, about one-tenth of a second, and that, where the impression is rendered complex by affording the mind a choice of sources to which it may be referred, the time required is increased by about another tenth of a second. An equally interesting side of the subject, however, is that which exhibits the force of impressions as modifying the rapidity with which they are accepted and, in familiar phrase, digested by the mental centres before they are visibly transformed into action. The rapidly energising power of sudden fear, joy, hope, and desire is thus explained. So likewise the contrary effect of some of these emotions may be explained as being due to a stunning effect produced by the causes which give rise to them upon the mental centres. It is also manifest that the energy of mental reaction must largely depend upon the reserve of force in those centres at the time of activity. They must not be overtaxed by prior stimulation and excessive use; if their response is to be a vigorous one, they must be well nourished and have seasonable rest, There is, therefore, even in these psychological minutiæ, a moral for the times—namely, that if we would preserve our mental efficiency amid the changing pressure of circumstances, we must by occasional recreation withdraw the mind from too continuous application.—*The Lancet.*

THE GROWTH OF RAINDROPS.

WHEN several rain gauges are set up in the same locality, but at different heights, a curious fact, says Mr. W. Mattieu Williams, in the *Gentleman's Magazine*, usually presents itself. "The quantity of rain that is falling on a given surface is shown to diminish with the height. This, according to ordinary notions of the supply of rain from the clouds, appears very paradoxical. Some meteorologists even question the accuracy of the rain-gauge record. Thus Professor Cleveland Abbe attributes the difference to the action of the stronger winds to which the rain-gauge is exposed when set high up. These, he suggests, carry the drops to one side, so that the higher gauge catches less than the lower one. I do not see how that accounts for the observed facts, but they are easily explained if we reflect a little on the ordinary physical conditions of rainfall. I say the 'ordinary' conditions, not the exceptional conditions. One of these ordinary conditions is that the air through which the drops of rain fall is fully saturated or even supersaturated with aqueous vapour; and another is that the temperature above is lower than that below, and therefore the drops of rain coming from above are cooler than the air through which they are falling. This being the case, each drop acts as a condenser to the vapour through which it is passing, and thus grows in size as it descends. This increase of the size of the drops has been well observed, and is not at all covered by Professor Abbe's explanation. The following is an experience of my own. I started on a 'soft day' to ascend Ben Nevis. Rain was falling at Fort William. At about halfway up the mountain there was a mixture of rain and sleet. Gradually the proportion of snowflakes increased, and finally, before reaching the summit, dry snow was falling. I have passed through the same series on other occasions. It would be the common experience of tourists, but for the fact that we rarely start to climb a mountain in wet weather. The characteristic 'nimbus' or rain-cloud is a cumulus or rounded cloud extending downwards in shapeless mass, cloud above, mist below. The whole cloud is a supersaturated stratum of atmosphere in the condition of condensation and precipitation, the rounded upper surface indicating the upper boundary of this condition. Rain is produced throughout this cumulo-stratus cloud at all elevations from its woolly summit down to its base, which very commonly rests on the earth's surface. There are occasions when raindrops diminish as they fall. This must of necessity occur whenever the rain is formed above a dry stratum. In such case the falling drops must rapidly evaporate. The north side of the Romsdal (Norway) is a magnificent wall of dark-coloured rock, ranging at the lower part of the valley from 2,000 to 3,000 feet in height. Over this are poured a multitude of cascades, some of them mere threads of water. On a clear summer's day the continuous sunshine warms the dark rock so effectively that some of these minor falls, after breaking as they all do into snow-like spray, vanish altogether by evaporation. I witnessed this on both my visits to this valley on hot days of different summers."

REVIEWS.

A Sketch of Geological History, being the Natural History of the Earth, and of its Pre-human Inhabitants. By Edward Hull, M.A., LL.D., F.R.S., Director of the Geological Survey of Ireland. (London : C. W. Deacon and Co.)

Professor Hull, in this work, fills up what has been hitherto a gap in our scientific literature. We have had many original treatises and memoirs on special departments of geology ; we have manuals and text-books not a few, but a compendious view of the main facts of the science, surveyed in historical succession, has hitherto been wanting.

We find here a condensed account of the history of our globe from the archæan or azoic age on to the appearance of man. The author, as it will be noted, touches but slightly upon hypothetical and controversial matter, confining himself to established facts. In speaking of the earlier condition of the crust of the earth, he notices that the Himalayas are still probably undergoing a movement of elevation sufficient to counterbalance the effects of denudation. As regards the internal temperature of the globe, he quotes the recent conclusion of Prof. Prestwich that the mean rate of increase is 1° Fahr. for every 47, feet in depth. He reminds us that in the earlier epochs certain forms of terrestrial activity must have been more intense than at present. The tides, in consequence of the greater proximity of the moon, may have been ten times as high as they are at present. Owing to the higher temperature evaporation would be more rapid and rainfall more abundant, whence erosion would be greater and the distribution of sediments far more extensive than we now witness. We note, not without satisfaction, that Prof. Hull, in accordance with Möbius, regards the *Eozoon canadense* of Prof. Sir W. Dawson as a purely inorganic formation.

Though distinctly an evolutionist, our author holds, with Charles Darwin, that we have, as yet, no natural explanation of the first appearance of life upon our globe, but must refer it to Divine intervention.

In the account of the principal coal-fields of the world, we find no mention of those of South Africa, which appear to be more important than those of the European continent.

The "glacial epoch" is duly described, but Prof. Hull expresses no opinion as to its causes.

The first appearance of man upon our globe is treated as an open question, though his existence in Miocene times is regarded as improbable, or at least as unproven.

The inrush of northern animals into Africa during the glacial epoch, and the extirpation of its original fauna—which now survives merely in Madagascar and the adjacent islands—is described in accordance with the views of Wallace. But of the three causeways along which this immigration may have been effected, viz., land joining Gibraltar to Africa, a similar connection between Sicily and Tunis, and the Isthmus of Suez, we must venture to throw some doubt upon the last. It seems not unlikely that the Red Sea was in connection with the Mediterranean until a later date. A valuable feature of this work is formed by the accounts of the probable distribution of land and water at different points of geological time. This book is one which ought to be read by every person who lays claim to a fair general education.

The Young Collector's Handbook of Ants, Bees, Dragon Flies, Earwigs, Crickets, and Flies. By W. H. Bath. (London : Swan Sonnenschein, Lowrey and Co.)

The author of this little book points out the immense advantages which the collecting of insects, shells, etc., has over amassing postage-stamps, crests, or other objects, which have no organic connection, and which can teach their owner nothing. Still, we do not at all wish to see the number of collectors of insects, etc., multiplied, unless they make collecting merely the basis for study and observation.

Boys who get together a considerable number of specimens, and in a short time let them go to ruin, often contribute no little to the extirpation of some of our finest species, and are, no less than is the bird-fancier, perfect abominations to the true naturalist. We are glad that Mr. Bath calls attention to the "neglected orders" of insects, in which there is, of course, very much to be done. At the same time we cannot agree with him when he says that "any one who wishes to commence the study of the Lepidoptera and Coleoptera will have to work very hard indeed before he can hope to put anything new on record concerning them." Of course, in the meagre fauna of Britain the prospect of discovering any new species is very slender. But there is an almost infinite amount of work needed before we understand their structure, their senses, their mental faculties, their mutual relations. And there is always the possibility that the young naturalist may settle in, or at least visit, countries whose fauna is richer and less known than that of our islands.

The descriptions of the various groups and of the few species mentioned, though necessarily very brief, are accurate. A few typographical errors occur ; thus, on p. 23 we find *Bembicidae* for *Bembicidæ*, and on p. 63 *Forficesita* for *Forficesila*.

We are glad to find attention drawn to the utility of some little-known species, such as the lace-winged flies (*Chrysopa vulgaris*) and the "hover fly" (*Syrphus pyrastri*), both of which are great devourers of aphides, and deserve our protection. In speaking of the ignoble group, *Pediculidae*, the author indulges in an expression which savours of vulgarity. He writes, "those found on niggers (*sic*) are black, and those on Europeans are whitish."

The book will form a very useful gift for boys placed where the study and observation of insects is possible.

Weather. A Popular Exposition of the Nature of Weather Changes from Day to Day. By the Hon. Ralph Abercromby, F.R.M.S., etc. London : Kegan Paul, Trench and Co.

This book forms Vol. lix. of the International Scientific Series, and is not only well worthy of taking its place among the other textbooks, but will be found to be of more general interest to the public than many of its fellows. We are told that many books have been written on storms and climate, but no attempt has been made to lay down the broad principles of the science of weather as a whole. The book consists of two parts, elementary and advanced. The latter part might have been divided into British and Foreign, as the latter present differences in many important characteristics of climate, which need hardly concern any one desiring to study the meteorology of this country.

We are glad to see that some attention is paid to

prognostics as a distinct and important branch, and one on which the sailor, the fisherman, the shepherd, and the "solitary observer," for whom one chapter is specially written, must rely, if he does not see the daily chart in the *Times* or elsewhere.

The first step which most persons take in the science of meteorology, is to expect fine weather when the barometer rises, and bad weather when it falls. The second step is to be so discouraged by the number of exceptions to this simple rule as to place little or no value on this instrument, which is imagined by some people to indicate rain as clearly as a thermometer shows temperature. The third step should be to read Mr. Abercromby's book. "Weather" in its strict sense is used to denote the actual appearance of the sky, the presence or absence of clouds, and whether rain, snow, or hail are falling, and excludes temperature and wind. It is generally known that there are two systems of recording the weather. The older method consists of a continuous chart, on which the fluctuations of the barometer, thermometer, direction and force of wind, and amount of rainfall are indicated by lines, which refer to appropriate scales of the various quantities. These charts generally show the successive changes that have taken place during one week at a certain observing station. The more modern system, which by no means supersedes the other, but forms a very important supplement to it, has been introduced within the last twenty years, and exhibits the state of the weather at a certain instant for a large number of stations.

By this method, a chart of a large area of the earth's surface is taken, and after marking on the map the height of the barometer at each place, lines are drawn through all stations at which the barometer marks a particular height. Thus a line would be drawn through all places where the pressure was 30·0 inches, another through all places where it was 29·8 inches, and so on at any intervals which were considered necessary. These lines are called "isobars," because they mark out lines of equal pressure.....After the isobars have been put in, lines are usually drawn through all places where the temperature is equal at the moment. Then arrows to mark the velocity and direction of the wind are inserted, and finally letters, or other symbols, to denote the appearance of the sky, the amount of cloud, or the occurrence of rain or snow. Such a chart is called a "synoptic chart." These are familiar to all readers of the *Times*, and constitute not only the source of our knowledge of many important facts in the science of weather which it was impossible to deduce from statistics, and explain why certain observations are quite useless, but enable very trustworthy forecasts to be made. This system of forecasting will undoubtedly be to most readers by far the most interesting part of the book. It is surprising that so little is known of the teachings of synoptic charts, for they are not in their infancy. It is impossible to give an idea in a short notice such as the present of the relations of wind and weather to isobars, but the following extract summarises the important generalisations which have been discovered, and will give an idea of some of the most interesting topics of the book.

1. That in general the configuration of the isobars assumed one of seven well-defined forms.

2. That, independent of the shape of the isobars, the wind always took a definite direction relative to the trend of those lines and the position of the nearest area of low pressure.

3. That the velocity of the wind was always nearly proportional to the closeness of the isobars.

4. That the weather—that is to say, the kind of cloud, rain, fog, etc.—at any moment was related to the shape, and not to the closeness of the isobars, some shapes enclosing areas of fine, others of bad weather.

5. That the regions thus mapped out by isobars were constantly shifting their position, so that changes of weather were caused by the drifting past of these areas of good or bad weather, just as on a small scale rain falls as a squall drives by. The motion of these areas was found to follow certain laws, so that forecasting the weather changes in advance became possible.

6. That sometimes in the temperate zone, and habitually in the tropics, rain fell without any appreciable change in the isobars, though the wind conformed to the general law of these lines.

The book is well illustrated by a number of typical and actual charts and diagrams, and a few less satisfactory representations of clouds. It is a great convenience to the reader if a diagram, to which constant reference is made, is placed on the left-hand page. Fig. 1 would be much more easily referred to if it were printed on page 24 or 26 instead of in its present position. Where the whole of the reference to the figure is contained on one page, as at Fig. 54, this is of no consequence. We notice a misprint, *marked* for *masked*, on p. 158, and *air* instead of *wind* on p. 35. The author falls into a somewhat amusing mistake on p. 115: "On one occasion the interval between the lightning and the thunder was five seconds, while the rain did not arrive for nineteen seconds. Now, calculating the distance of the origin of the lightning from the velocity of sound, we find the altitude to be 5,500 feet; while the distance through which a drop would fall in nineteen seconds would have been 5,800 feet. The difference is only 300 feet, which is very little, considering the nature of the observations and the unknown retardation of a falling drop from the resistance of the air." Taking a drop as $\frac{1}{480}$ of an ounce, the effect of the blow, if it were to fall 5,800 feet in nineteen seconds, would be equal to that of one ounce falling 25 feet, or a quarter of a pound falling about 19 inches. We pause for a moment to let a four-ounce weight from a letter-balance fall from this height on our knuckles, and cannot help realising that we owe a debt of gratitude to the resistance of the air. It is probable that after the first 5 or 10 feet, a drop falls at the uniform rate of 18 to 20 feet a second. This allows less than 400 for the case described by the author, whom we must leave to account for the discrepancy.

Experimental Chemistry for Junior Students. Part IV. By Professor Emerson Reynolds, M.D., F.R.S., F.C.S. London: Longman, Green, and Co.

This work concludes the author's course of Experimental Chemistry, and is the most readable organic chemistry with which we are acquainted. Commencing with the manufacture of methyl and ethyl alcohol, the author builds up synthetically most of the compounds he describes. The student who carefully performs the experiments mentioned in this book will find he has obtained a very fair insight into this branch of chemistry.

We regret the author has not provided this useful little book with an index, but this omission will probably be remedied in the next edition.

In the appendix a description is given of Victor Meyer's method of determining vapour densities.

Chemistry and Heat—Laws and Definitions. By R. G. Durrant, M.A., F.C.S., Assistant Master at Marlborough College. London: Rivingtons, 1887.

This little book of ninety-nine pages contains the essence of many big volumes. It is, in fact, the sort of condensation which a clever and very industrious student aims at making for himself while going through his course of reading—*aims at*, we say, but rarely reaches.

Laws and definitions are given with accuracy and clearness, and good examples are added throughout. The beginner will find it useful as an adjunct to his fuller work, and the advanced student may, with its aid, quickly refresh his memory and re-arrange his facts. For examination purposes it will be particularly valuable.

The printing and the general get-up are neat and attractive. We have found only one mis-print—on page seventy, N_2O being given as N_3O—and usually misprints in books on chemistry are numerous.

The Stevens Indicator. Vol. iv., No. 4.

This journal is the organ of the School of Mechanical Engineering connected with the Stevens Institute of Technology. Perhaps the most noteworthy matter the present number contains is to be found in the addresses delivered to the graduates. Said one of the speakers: "You are to be spared this evening any direct reference to the 'conceit of learning,' but you are asked and advised to bear with the *conceit* of *ignorance*. . . . The most disagreeable man about the establishment who perhaps goes out of his way to insult you may be one who can be of greatest use to you."

Afterwards follows advice on dealing with strikes, "walking delegates," etc., from which it may be gathered that these nuisances are not less rampant in the United States than in Europe.

A paper on Inter-collegiate boat-racing contains a curious calculation. It is shown that each rower performs work each minute equivalent to the work of seven strong labourers, and at the rate of very nearly one-third of a theoretical horse-power each minute during the race.

The Photographer's Indispensable Handbook. Compiled by Walter D. Walford, edited by Henry Sturmey. London: Iliffe and Sons.

This is a complete cyclopædia on the subject of photographic apparatus, materials, and processes. It is a compilation from the catalogues of various firms, and is profusely illustrated. One of the best sections of the book is that on formulæ and instructions. A few words on the selection and testing of lenses would have been acceptable, as if the lens be bad it is impossible to do good work. On the whole we can, however, strongly recommend this work to the attention of all those interested in photography, as it plainly brings before the reader the merits and demerits of the various forms of photographic apparatus and appliances.

Journal of the Scottish Meteorological Society. Series 3; Vol. IV., for 1886.

Perhaps the most interesting paper in this yearly volume is that comprising the results of the biological work of the Scottish Marine Station. Some years ago this establishment might have been more conveniently called an "aquarium," but now that term has been usurped by places of amusement, we are obliged to give the genuine aquarium a different name. The work done has been good. The first portion consisted in determining the local faunas of the Friths of Forth and Clyde. The decapod and schizopod crustaceans have next been reviewed. From a practical point of view the most important study has been the reproduction and development of the borer, or hag-fish (*Myxine glutinosa*), one of the deadliest enemies of our food-fishes. A thorough knowledge of this pest is needed, that we may attack it with advantage. Researches on the spawning of herrings and the spatting of oysters have been carried on at May Island and at Granton. Two important memoirs have been drawn up by students working at Granton. One of these treats on the "Physiology of the Nervous System in the Lobster," and the other deals with the phosphorescence of *Nycphanes Norwegica*.

THE EFFECT OF LIGHT ON PLANTS.

THE herbalists of old, after the experience of a life in collecting plants for their medicinal preparations, observed the peculiarities of these plants at different times of the day and night, and even under different phases of the moon. This was long looked upon as a superstitious craze—a remnant of alchemy and magic. The rules of these herbalists, however, deduced centuries ago after careful observation, are now being explained. Long were they laughed at as mere delusions, but Sachs, the highest authority on the physiology of plants, has demonstrated their truth. His observations show that the amount of starch present in the leaf of any given plant varies considerably under different circumstances. When the sun shines brightly and directly upon the plant, without much wind, starch is formed very rapidly. During the night, again, this starch generally disappears. Accordingly, leaves collected at sunset are full of starch, whereas the leaves of the same plant gathered at daybreak are quite destitute of it. Sachs has given us the best means of detecting the existence of starch in leaves. The leaf to be examined is first plunged into boiling water for about ten minutes, then taken out and digested in alcohol for about the same time. The whole of the colouring matter is thus extracted, and the leaf is left quite white. If the leaf be now placed in an alcoholic solution of iodine, the existence of starch can be instantly detected. If much starch be present, the leaf turns blue-black; if the quantity of starch be but small, it becomes only brown; if there is no starch, no change occurs. The veins of the leaf form a pale network on a dark ground, rendering it a very beautiful object. Sachs has not yet succeeded in preserving one of these specimens of venation beyond a few hours. The variations in the amount of starch in the leaves of plants at different periods of the day and night arrest the observer's attention, for they render it possible that the amount of some of the poisonous alkaloids formed by the decomposition of albuminous substances may vary in a similar way. This is quite a new study. The influence of light on plants may yet prove of great practical importance in medical art.

A LARGE METEORITE.—On August 13th last there fell at Taborg, in Russia, a meteorite of which the larger fragment weighed upwards of 250 lbs. It is strongly magnetic, and contains abundance of native iron.

ABSTRACTS of PAPERS, LECTURES, etc.

ROYAL INSTITUTION.

The Sun.

The Christmas lectures, adapted to a juvenile auditory, were given this season by Sir Robert Ball, Astronomer Royal of Ireland, who commenced the series with a discourse about the sun. He spoke of the heat and brightness of the sun, and of its immense importance to us, though it was not the largest body in the universe. Lantern views were thrown upon the screen, representing instruments used in astronomy, from the apparatus of Tycho Brahe to the great Vienna telescope and the telescope of Lord Rosse. The telescope of the Dublin Observatory, with an object glass twelve inches in diameter, had been considered to be at the head of its class until lately, when there had been an international competition to possess the largest. America obtained a larger one, and then the Austrian Government determined to possess one larger still, and the telescope at Vienna, made in Dublin, had a glass of twenty-seven inches in diameter. Now, he remarked, the Greenwich authorities, resolving not to be behind, had ordered a telescope from Dublin which should be bigger than the great Austrian telescope. Sir R. Ball referred to the recent bright appearance of Venus, which so many persons persuaded themselves was the "Star of Bethlehem," appearing only once in 300 years. He did not know what had set this extraordinary story going, but as Venus appeared as a morning or evening star once in a year and seven months, it followed that it must sometimes be seen in that capacity at Christmas time, and he supposed that that fact had acted on people's imagination. The alternation of day and night, and the long arctic day and night, were demonstrated, and sun spots were exhibited on the screen in great variety, and their nature explained. In conclusion, the lecturer, pointing to a globe ten inches in diameter, taken to represent the sun, held beside it a shot, No. 5, which showed the comparative size of the earth.

The Moon.

In the second lecture, after having presented a picture of the surface of the moon as revealed by the telescope when viewed in the form known as full moon, the lecturer proceeded briefly to impart to his young hearers such information with regard to its form and substance as has been gained by means of the telescope and photography. It was 2,000 miles across, and evidently of volcanic origin. So far away was our satellite that even if it produced elephants as large as cathedrals they would appear to us no larger than mites moving about; but there was good reason to conclude that there was no life upon the surface of the moon. Sir Robert Ball then explained the phases of the moon, and showed, by means of globes exposed to the electric light, how it was that the moon appeared sometimes "full," and sometimes "new." By a similar method of illustration the lecturer explained the reason why the planet Venus shines with so brilliant a light just before sunrise or after sunset. He touched upon the eclipse phenomenon, and showed a number of pictures and diagrams illustrating the character of the moon's surface. Among these were the Plato crater and other extinct volcanos which have been carefully mapped by astronomers. The presence of ocean beds was also demonstrated, and it was explained that, many ages yet to come, it was possible that the waters of the earth might in like manner be dried up, and the beds of the ocean remain to tell the tale to the inhabitants of other planets. The relative sizes of the earth and the moon were next considered, and by means of red-hot globes of iron the process of cooling was illustrated. A model of a lunar crater was also exhibited, and the method of measuring the heights of the mountains and the diameters of the craters was explained.

The Small Planets.

Sir Robert Ball in the third lecture dealt with the small planets embraced within our solar system. After explaining at some length the theory of gravitation, and showing how the sun controlled the movements of the various celestial bodies included in his system, the lecturer elucidated the way in which the planets derived the light which renders them so conspicuous at night, while by day they are not distinguishable. Diagrams were shown in which the relative sizes of the great and small planets were set forth and the nature of their orbits illustrated. The varying character of the movements of Mercury, Venus, and the earth were also portrayed, and the different periods at which the planets appeared to cross the sun's disc were fully explained. The phases of Venus were graphically illustrated by the aid of the electric light, and again referring to the recent speculation concerning the Star of Bethlehem, the lecturer remarked that, notwithstanding all that had been said and written, he was continually being asked by anxious inquirers as to whether Venus was the identical star in question or not. Sir Robert Ball then proceeded to illustrate the so-called transits of Venus, and showed why so much anxiety was displayed by astronomers to observe the phenomenon on those rare occasions when it occurred, and the difficulties under which their observations had to be conducted. One important result which was obtainable from an accurate observation of the transit was a reliable estimate of the actual distance which separated the earth from the sun; and without being particular to an inch or two, astronomers had been enabled to fix the interval at 92,700,000 miles. The lecturer then explained the varying seasons of the earth as caused by the inclination of its axis, which was duly illustrated by experiment. Another experiment which occupied some time was the explanation by means of Foucault's pendulum of the revolution of the earth. Some diagrams of Mars were shown, and in reference to the curious parallel lines mapped by Schiaparelli, Sir Robert Ball remarked that many theories had been advanced by way of explanation. Among others, it had been suggested by a citizen of Manchester that no doubt one line represented a railway between two commercial centres, while the parallel was formed by an opposition canal. The two satellites of Mars were also shown, and, alluding to the fact that one of them revolved round the planet once every seven and a half hours, the lecturer drew attention to the fact that in "Gulliver's Travels" Swift had represented the philosophers of Laputa as having discovered that Mars had two satellites, one of which revolved its course in nine hours. This was put forth as a ludicrous idea, but truth had actually proved stranger than fiction.

GEOLOGICAL SOCIETY.

On December 7th, 1887, the communications read were:—

1. "A Letter from H.M. Secretary of State for the

Colonies, enclosing an account of recent Discoveries of Gold in the Transvaal."

The deposits in which gold has been found, locally known as "banket," consist of a quartz-conglomerate forming so-called "reefs," which traverse the veldt parallel to, but at a short distance from, the rocky ridge of Witwatersrand. The "main reef" has been traced for twenty-five or thirty miles, and varies in breadth from 3 feet 6 inches to 15 feet; parallel and branching "reefs" of smaller dimensions have also been found. The yield of gold is said to be very variable in different portions of the "reef," different samples with from 3 oz. to ½ oz. per ton occurring in close proximity. So far as observation has gone (and the deepest workings have only reached a depth of from 70 to 150 feet), the yield of gold has generally increased as the reefs are followed downwards.

2. "On the Age of the Altered Limestone of Strath, Skye." By Dr. Archibald Geikie, F.R.S.

The remarkable alteration of the limestone of Strath into a white saccharoid marble, first described by Macculloch, has hitherto been regarded as an instance of contact-metamorphism in a rock of Liassic age. The author now offers lithological, stratigraphical, and palæontological evidence that the altered limestone is not Lias but Lower Silurian.

In lithological characters the limestone, where not immediately affected by the intrusion of the eruptive rocks, closely resembles the well-known limestones of the west of Sutherland and Rosshire. It is not more altered than Palæozoic limestones usually are. It contains abundant black chert concretions and nodules, which project from the weathered surfaces of the rock exactly as they do at Durness. These cherts do not occur in any of the undoubted Lias limestones of the shore-sections.

The stratigraphy of the altered limestone likewise marks it off from the Lias. There appears to be a lower group of dark limestones full of black cherts, and a higher group of white limestones with little or no chert, which may be compared with the two lower groups of the Durness Limestone. A further point of connection between the rocks of the two localities is the occurrence of white quartzite in association with the limestone at several places in Strath, and of representatives of the well-known "fucoid beds" at Ord, in Sleat.

Palæontological evidence confirms and completes the proof that the limestone is of Lower Silurian age. The author has obtained from the limestone of Ben Suardal, near Broadford, a number of fossils which are specifically identical with those in the Durness limestone, and so closely resemble them in lithological aspect that the whole might be believed to have come from the same crag. Among the fossils are species of *Cyclonema*, *Murchisonia*, *Maclurea*, *Orthoceras*, and *Piloceras*.

3. "On the Discovery of Trilobites in the Upper Green (Cambrian) Slates of the Penrhyn Quarry, Bethesda, near Bangor, North Wales." By Dr. Henry Woodward, F.R.S.

The absence in Wales of organisms in the Longmynd and Harlech group renders any discovery of fossils in beds of this early horizon of the utmost importance. A portion of a Trilobite (*Palæopyge Ramsayi*) and Annelide burrows had already been found; but Dr. Hicks, at St. Davids, has added a sponge, 2 Ostracods, 6 Trilobites, 2 *Lingulellæ*, and 2 *Thecæ* (*Agnostus*, *Plutonia*, *Paradoxides*, *Conocoryphe Lyelli*, *C. bufo*, and *Microdiscus sculptus*). Dr. Hicks has pointed out the singular absence of organic remains in the Longmynds both in Shropshire, N. Wales, and Ireland, and has urged the need of further explorations. As if in answer to this, the author has received from Prof. Dobbie an impression and counterpart of a Trilobite from Bethesda, near Bangor, about 3½ in. long and 1¾ in. broad. These specimens were obtained from the Upper Green bed of the quarry, which immediately underlies the grits forming the brow of Bronllwyd and above the Purple Slates.

4. "On *Thecospondylus Daviesi*, Seeley, with some Remarks on the Classification of the Dinosauria." By Prof. H. G. Seeley, F.R.S.

The author described the anterior third of a vertebra from the Wealden, which was recognised by Mr. Davies as the cervical vertebra of an animal allied to the genus *Cœlurus*, Marsh. The only European genus hitherto described in which the vertebræ are similarly elongated, compressed, and enveloped in a dense external film of bone is that indicated by the saurian, named *Thecospondylus Horneri*, whose vertebræ are about 11 centimetres long, whilst the cervical vertebræ now under discussion were 9 centimetres long when complete. The specimen has lost the prezygapophyses and cervical ribs. If these were restored they would probably approximate in shape to those of *Cœlurus fragilis*.

ROYAL SOCIETY OF EDINBURGH.

At the meeting on December 19th, Sir Douglas Maclagan, Vice-President, in the chair, the following communication was read by Dr. J. Murray on "The Height and Volume of Dry Land, and Depth and Volume of the Ocean":—Only 2 per cent. of the waters of the ocean, the author said, lay between the surface and a depth of 500 fathoms, while 77 per cent. was situated between depths of 500 and 3,000 fathoms. Beyond the latter depth there was only about 1 per cent. of the bulk of the ocean. The mean height of the land of the globe was 250 feet above the sea level, and the mean depth of the ocean 12,480 feet. The mean depth of the area beyond 4,000 fathoms was 14,640 feet. The transitional area occupied 24,000,000 square miles, and the abyssmal area was situated fully three miles below the average heights of continents, and occupied 113 miles or square miles, or more than half of the surface of the earth. The deposits in that region were, in most respects, quite similar to those which made up a very large part of the sedimentary formations of the dry land. In the abyssmal area there was a great abundance of animal life, but the forms from various parts of the area were very similar and unlike those of shallower waters, and the deposits unlike any of the sedimentary deposits of the dry land. If the land of the globe were reduced to the sea level by being removed to and filled up in the shallower waters of the ocean, its extent would be about 80 million square miles, and the rest of the surface of the earth would be covered by an ocean of 113 million square miles. Should the whole of the solid land be reduced to one level under the ocean, the surface of the earth would be covered by an ocean with a uniform depth of about two miles.

Sir. W. Turner described, by the aid of diagrams, the formation of the pineal gland in the walrus, stating that he had had three opportunities of examining the brain of that animal. It was interesting, he said, to know that

there was one mammal at least in which the pineal body did not present itself in such a rudimentary and abortive form as it did in the human frame, entirely concealed, and only to be seen when dissected.

Dr. B. Bramwell described a series of investigations he had made, and an apparatus he had, by the assistance of Dr. Milne Murray, prepared for graphically recording the exact time relations of cardinal sounds and murmurs. The impressions made upon smoked paper placed in the apparatus, which embraced the use of a flexible tube stethoscope, a telephone, and a species of graphophone, were very satisfactory, and tracings of them were exhibited to the meeting by means of a lantern.

Professor Crum Brown described the contents of a paper on "Benzyl Phospines," by Professor Letts.

Dr. H. R. Mill read a criticism of the theory of subsidence as explaining the origin of coral reefs, prepared by Dr. Guppy, R.N., in which the writer sought to show that Darwin, in his works on coral reefs, had accepted rather than formed the subsidence theory, which, in the light of later ocean investigations, was no longer tenable. An examination of the barrier reefs of Solomon Islands and other upraised coral formations had proved that they could be formed without any subsidence, as shown by Dr. Murray, of the *Challenger* Expedition.

Professor Tait gave a communication on "The Compressibility of Water, and of different Solutions of Common Salt." He showed in algebraic formulæ the results of certain experiments he had made to ascertain the effect of various degrees of pressure upon water. In the interior of a mass of water, he said, there was already a pressure of thirty-two tons to the square inch. Sea water was less compressible than ordinary water, the presence of a number of particles of salt tending to pack them more closely together, and increase the pressure, which in sea water was thirty-five tons to the square inch.

ROYAL METEOROLOGICAL SOCIETY.

At the meeting held on Wednesday, the 21st December, Mr. W. Ellis, F.R.A.S., President, in the chair, the following papers were read :—

(1) "The Mean Temperature of the Air at Greenwich, from September, 1811, to June, 1856," by Mr. H. S. Eaton, M.A. This is a discussion of the meteorological journals of the late Mr. J. H. Belville and those of the Royal Observatory. The general results of this investigation are :—1. That there was no appreciable change in the mean annual temperature of the air at Greenwich in the period 1812 to 1855, inclusive. 2. That on the eminence on which the Royal Observatory is situated the average temperature in the early morning is, in all cases, higher than over the lower grounds. 3. That with a north wall exposure, higher maximum temperatures are found at the lower stations. 4. That the movements of the thermometer are retarded with a north-wall exposure, as compared with an instrument on an open stand.

(2) "Report on the Phenological Observations for the year 1887," by the Rev. T. A. Preston, M.A. The past season was a most exceptional one. For flowers it was disastrous; fruit was generally a failure. Vegetables were universally poor, roots were destroyed by insects or drought, and green crops soon passed off. The wheat crop, however, was better than was expected. Barley on light lands was poor, but that which was sown early was satisfactory. Meadow hay was not up to an average crop, but clover and seed hay were much more nearly so.

(3) "Earth Tremors and the Wind," by Professor John Milne, F.R.S. From a comparison of the tremor records of Tokio and the Japanese tri-daily weather maps, the following conclusions have been drawn :—1. Earth tremors are more frequent with a low barometer than with a high barometer. 2. With a high barometric gradient tremors are almost always observed. 3. The stronger the wind the more likely it is that tremors should be observed. 4. When there has been a strong wind and no tremors the wind has usually been local, of short duration, or else blowing inland from the ocean. 5. When there has been little or no wind in Tokio, and yet tremors have been observed, in most cases there has been a strong wind in other parts of Central Japan. 6. From 75 to 80 per cent. of the tremors observed in Tokio may be accounted for on the supposition that they have been produced either by local or distant winds. 7. The only connection between earth tremors and earthquakes in Central Japan is that they are both more frequent about the same season.

(4) "Pressure and Temperature in Cyclones and Anti-cyclones," by Prof. H. A. Hazen. From a comparison of the observations at Burlington, and on the summit of Mount Washington, U.S.A., and as the result of a study of about 4,000 observations from two days before till two days after the passage of cyclone and anti-cyclone centres, the following conclusions have been drawn :—1. In both cyclones and anticyclones the pressure lags from 10 to 11 hours at the summit of Mt. Washington. 2. The temperature change at the base precedes very slightly the pressure change, but at the summit the change occurs nearly twenty-four hours earlier. 3. The temperature change appears earlier at the summit than at the base, and varies much more rapidly at the former. 4. In a cyclone the difference in temperature between base and summit is less than the mean before the storm, but the difference rapidly increases after the centre has passed. Just the contrary is true in an anticyclone. 5. The total fall in pressure in a cyclone at the summit very nearly equals that at the base, and likewise the rise in an anticyclone. 6. The fluctuation of temperature, that is, from the highest to the lowest, at the summit is double that at the base in a cyclone, but it is only a little greater in an anticyclone.

ZOOLOGICAL SOCIETY OF LONDON.

At the meeting of the Society, held on the 20th December, Professor W. H. Flower in the chair, Mr. Sclater read a letter from Dr. H. Burmeister, containing a description of a supposed new humming bird from Tucuman. Mr. Sclater proposed to call this species, of which the type was in the National Museum of Buenos Ayres, *Chætocercus burmeisteri*. The secretary exhibited, on behalf of Major Yerbury, a pair of horns of the oorial (*Ovis cycloceros*), which formerly belonged to the Royal Artillery Mess at Fort Attock, and were stated to have been originally obtained in the Chitta Pahar Range, a few miles south of Attock. These horns were apparently of a form which has been described by some naturalists as a distinct species. The secretary read an extract from a letter received from Mr. H. M. Phipson, of the Bombay Natural History Society, offering some living snakes for the society's collection. Mr. F. E. Beddard read a paper on Hooker's sea-lion, *Otaria* (Arctocephalus) *hookeri*, based upon the specimens of the species recently received by the Society, one of which had lately died. The author called attention to the external features, visceral anatomy,

and osteology of this species, in comparison with the corresponding characters of other species of the group. The secretary stated that four species of Otaria had been received in the Gardens, but that the largest of the group, *Otaria stelleri*, was still a desideratum. Mr. G. A. Boulenger read the description of a new genus of lizards of the family Teiidæ, founded on a specimen presented to the British Museum by Mr. H. N. Ridley, who had obtained it in the forest of Iguarassee. Pernambuco. The author proposed to name this lizard *Stenolepis ridlevi*. A communication from the Rev. H. S. Gorham, entitled a "Revision of the Japanese Species of Endomychidæ," was read. In this paper three new genera and thirteen new species were characterised and described. Additional observations were made upon the species previously known to inhabit Japan. The new species were obtained by Mr. George Lewis on his last journey to the islands in 1880-81. Mr. G. A. Boulenger gave an account of the fishes of the Persian Gulf, obtained by Surg.-Major A. S. G. Jayakar at Muscat, east coast of Arabia, and which had been presented by him to the British Museum. The collection contained specimens of 172 species, many of which were unrepresented in the national collection, and fifteen of which were apparently new to science. Mr. H. Druce read a paper containing descriptions of some new species of *Lepidoptera Heterocera* from Tropical Africa.

BIRMINGHAM AND MIDLAND INSTITUTE.

A LECTURE on "Invisible Stars" was delivered on Monday evening, December 15th, by Sir Robert S. Ball, Astronomer Royal for Ireland. He remarked that, although the title of his lecture might seem a little paradoxical, it was a fact that the normal condition of the stars was properly represented by the term invisible, for it was only for a comparatively small portion of their existence that they were visible. There were multitudes of stars which were now in the invisible stage of their existence. How did we know of these? Sometimes by their obscuring the brighter stars, the star Algol—known as the demon star—for instance, being periodically eclipsed by a body moving round it. Evidence of the existence of other invisible stars was afforded by the perturbations which their presence caused in what would otherwise be the regular motions of visible bodies. There were multitudes of other invisible stars which had been discovered by means of photography. There were waves of light which came either too quickly or too slowly to affect our sense of light. The former, however, had a marvellous effect on the sensitised photographic plate.

A general photographic survey had been arranged among astronomers, and it was hoped that in a few years it would have covered the whole surface of the heavens. The first object was to complete the inventory work—the mapping out of the heavens—which the astronomer regarded as so important. But there was a very grand result to be expected from this investigation. It was known that our sun and all its planets were moving on a mighty voyage together through space. Just as the mariner, by observing the bearings of the different lights on shore, and by watching them change their apparent positions and open out in front of him, could ascertain his position and shape his course into harbour, so, by the aid of photography, we could see the groups of stars towards which we were approaching open out, and could judge of the direction and the speed of our mighty celestial voyage.

ENTOMOLOGICAL SOCIETY.

AT the meeting held on December 7, 1887, Dr. David Sharp, President, in the chair, Mr. Waterhouse exhibited a series of diagrams of the wings of insects, and read "Notes of observations on the homologies of the veins"—a subject to which he had given especial attention for some time past. Mr. Gervase F. Mathew, R.N., communicated a paper entitled "Life-histories of Rhopalocera from the Australian Region." The paper was accompanied by elaborate coloured drawings of the perfect insects, their larvæ and pupæ. Mr. Frederic Merrifield read a "Report of Progress in Pedigree Moth-breeding, with observations on incidental points." He also exhibited a large number of specimens of *Selenia illustraria*, showing the results of the experiments he had been making.

TECHNICAL EDUCATION NOTES.

WARWICK.—The Speaker, in distributing the School Board prizes, remarked on the recent progress of education. At the same time he did not consider that our position as regards technical education was satisfactory, if compared with that of Continental nations.

CIVIL AND MECHANICAL ENGINEERS SOCIETY.—In his opening address, the President, Mr. R. E. Middleton, remarked that students of engineering now had much better opportunities of learning the science and technique of their profession than formerly. Instead of there being only one engineering school, there are now in England ten principal engineering laboratories, while in London alone there are six well-known schools.

PFORZHEIM.—The methods of production of jewellery work at Pforzheim, in Baden, are very similar to those in the United States, except that the German has the advantage of being provided with a very excellent technical school, or *Gewerbe schule*, in which children intended for employment in the jewellery shops receive a thorough theoretical training long before they see the inside of a factory. Instruction here is practically free, the manufacturers paying about 8s. a year for the pupils whom they intend to employ.

BURNLEY.—Sir James Fergusson, M.P. (Chairman of the Factory Commission), in distributing the prizes to the successful students at the Mechanics' Institute, said, something more was required than the instruction given at present in our schools to furnish the means for those engaged in industrial employment to improve their position. Commercial and industrial education should be systematised, and that was now recognised as an incumbent duty upon the Legislature. Whereas foreign nations, and especially Germany, were doing so much to instruct their people thoroughly in technical, commercial, and industrial education, we had as yet done almost nothing, and had left private organisation and enterprising individuals to provide for that which the State had left undone.

MECHANICAL DRAWING IN HOROLOGY.—An important outcome of technical classes for watchmaking is the attention now devoted to mechanical drawing, an art formerly all but unknown to the rank and file of watchmakers. Yet, owing to the very minute size of the actual parts, it is impossible for the young craftsman to gain a knowledge of the principles on which watches are constructed so readily as by setting out escapements and other parts to an enlarged scale on paper. Most of the drawings shown at the exhibition at the People's Palace possessed some features of excellence, and one or two of the executants exhibited special ability in this direction. The plans and elevations were particularly neat and useful.—*Horological Journal.*

CAMBRIDGE.—The Non-Collegiate Students' Board announce that an exhibition of £52 10s. a year, granted by the Worshipful Company of Clothworkers for the encouragement

of proficiency in physical science, will be awarded by means of the examination for certificates to be held in July, 1888, under the authority of the Oxford and Cambridge Schools Examination Board. The exhibition will be tenable for three years by a non-collegiate student of Cambridge or an unattached student of Oxford. Candidates must be non-collegiate students of one term's standing, or persons who have not yet commenced residence at either University, and the successful candidate must on election be admitted, if not already admitted, and begin residence in the following Michaelmas Term. Full information as to the subjects of examination, the conditions of tenure of the exhibition, and the preliminary steps to be taken by candidates may be obtained from the Rev. F. G. Howard, M.A., the Censor of Non-Collegiate Students, Cambridge.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

WATER SNAILS IN AN AQUARIUM.

I have an aquarium in which there are some water snails, and I shall be glad if any of your correspondents will explain to me how these snails manage to rise from the bottom to the top of the water without apparent effort. It may be that in some way they increase their volume when they wish to rise, and that as their specific gravity is so near to that of water, they then begin to float. INQUIRER.

THE EFFECT OF BAYONETS ON RIFLE FIRING.

I saw it stated the other day in a north-country newspaper, that when a rifle is fired with the bayonet fixed a deflection is caused in the flight of the bullet, and that this deflection averages from 12 to 18 inches to the left at all ranges up to 300 yards. I shall be glad to know if this has been observed by any of your readers, and if so what is the probable explanation of the occurrence. MILITIA.

BRITISH SPECIES OF VIPER.

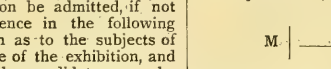
I find that a writer in one of your contemporaries seeks to revive the view of our earlier naturalists, that we have in Britain three distinct species of viper, viz., the common, the red, and the black. It seems to me that the black is merely a local variety peculiar to mountains. Over the Continent the reptiles of such districts are of a darker colour than their nearest representatives in the plains. The red viper I should take to be the young female, which when mature assumes more of a copper colour. R. M. N.

A CURIOSITY IN CALCULATION.

I was lately reading the article "Quaternions" in the new edition of the "Encyclopædia Britannica," and I noticed that it bore the well-known initials of P. G. T. What was my surprise, therefore, to find in it the following statement:—In the case of time, measured from the Christian era, this distinction is at once given by the letters A.D. or B.C., prefixed to the date. And to find the position, in time, of one event relatively to another, we have only to subtract the date of the second (taking account of its sign) from that of the first. Thus to find the battles of Marathon (490 B.C.), and Waterloo (1815 A.D.), we have $+1815-(-490)=2305$ years!"

I would not have troubled you about this, but it strikes me forcibly that Professor Tait has here, not only made a slip, but has overlooked an important principle in calculation. Without going into the minutiæ of the alteration of the Calendar at different times, we are accustomed in historical calculations to look upon all the years as of the same length. To illustrate this more plainly. Suppose these battles happened on the same day of the same month; then the number of years which intervene between these dates is NOT 2305.

For let us consider the interval between the 1st December in the year 1 B.C., and the 1st December in the year 1 A.D.



Let N in this diagram represent the position in time of the commencement of the Christian era, M N the year 1 B.C., N T the year 1 A.D.; FOR THERE NO YEAR O. Let H be the position of the 1st of December in the year 1 B.C., and R the position of the 1st December in the year 1 A.D. What is the interval between H and R? Evidently only ONE year. That is plain, by measurement, at the first glance. We have, then, between the 1st December in 1 B.C. and the 1st December in 1 A.D., the interval NOT of $1-(-1)$, or two years, but of one year; that is ONE LESS than the sum of 1 and 1.

With the extension of the same reasoning, the interval between, say, 1st December, 490 B.C., and 1st December, 1815 A.D., is *one less than the sum* of these numbers, *i.e.*, 2304 years.

I shall be obliged for the opinion of any of your readers on this subject. F. R. S. E.

MEAN VELOCITY OF THE WIND.

Is there any positive evidence whether or no the climate of England has become windier than it was some two or three centuries ago? I should incline to the affirmative view, on two grounds: 1st, the prevalence in old directions for foretelling the weather, of the rule that it will be fair if smoke ascends straight upwards, but that rain may be expected if it falls. In our days smoke very rarely either rises or falls, but is hurried along in a nearly horizontal direction from the top of the chimney; 2nd, that in the Book of Common Prayer there is no form of supplication for deliverance from destructive and unseasonable winds.—CLOUD-GAZER.

PUMPING BY ELECTRICITY.

THE pumps used for raising the water in mines are generally driven by the pneumatic or hydraulic power. The former requires a large initial outlay, and the losses in transmission through horizontal pipes for long distances are also considerable. The latter is frequently a cheap and convenient way of transmitting power if there be a sufficient head of water, but usually an engine and accumulator are required on the surface, and heavy piping must be provided. The great objection is that water has to be taken down the mine to raise the water which is already there, and if the plant be worked at high pressure, the cost of maintenance is considerable.

About four years ago Mr. W. B. Brain tried a pump driven by electricity in a small colliery in the Forest of Dean, and since then two other pumps have been started there. More recently Messrs. Immisch and Co., of Kentish Town, have erected electrical pumping apparatus at St. John's Colliery, near Normanton, which has proved very successful. Wherever the requisite power exists, it is only necessary to add a dynamo, a motor, and conducting wires. The initial cost is then about the same as for the pneumatic system; but the cost of working is much in favour of electricity, as the current can be so easily conducted to the place where it is required without appreciable loss in efficiency.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

OPSIOMETER.—Mr. E. Barnard, of Cirencester, has patented an opsiometer. It is an instrument whereby lenses, fixed at a normal reading distance from printed matter, shall, by means of a disc, cylinder, or other means, be made to revolve before both eyes of a person who looks through two eye openings (shaped something like an opera-glass), who thus readily ascertains the power of lens required in selecting a pair of spectacles, etc.

MUSIC PORTFOLIO.—Mr. E. Holmes, of Bewdley, Worcestershire, has patented a music portfolio. It is provided with a solid wood back, oval-shaped on the outside, but flat inside, and capped at each end with perforated brass plates, projecting quarter-inch over the inside edges of the back, to be threaded with a tier of cords allowing pieces of music to be easily inserted or taken out.

MOULDING ARTIFICIAL FUEL.—An apparatus for moulding blocks of artificial fuel has been patented by Messrs. Mulheims and Zimmermann, of Nœuf-les-Mines, France. Briefly the action is as follows:—The pasty material is passed into shoots, and falls between two cylinders revolving in opposite directions. The moulding and agglomeration take place in passing between the two cylinders, and is performed by mechanical compression.

SOUNDING BOARD FOR VIOLINS.—Mr. P. H. Zeidler, of Hammersmith, London, has patented a sounding board for violins. The invention consists in producing a sound-board of two separate archings, so as to gain more elasticity, and thereby obtain longer and purer vibration, and produce a more mellow and powerful tone. The board is made as follows: The upper and lower archings are each worked out separately, and then one is fixed on the top of the other.

CINDER SIFTER AND HOUSEMAID'S BOX.—Messrs. B. W. and H. M. Dove, of Islington, London, have patented a combined cinder sifter and housemaid's box. The invention consists of a combination of cinder box and sifter, having a shovel provided with a spring lid, also receptacles for brushes, etc. The dust or ashes are taken up by means of the spring lid shovel, placed in the box through a hinged hanging-flap, received on the movable sifter beneath in the shape of a wire-bottomed shovel placed in the body of the box, the dust passing through the wires and falling into a movable receiver beneath, the cinders remaining; the shovel sifter can then be withdrawn and the cinders used as required, and the receiver emptied of dust.

FIRE-ESCAPE.—Lieut.-Col. E. R. Wethered, of Woolwich, has patented a fire escape. The object of this invention is to provide a friction pulley-block, with other attachments suitable for a fire-escape, the pulley-block being constructed to act universally and automatically, so that either end of the rope can be used alternately for lowering, the rope rove through the block being pressed or nipped between one or other of the pulley wheels and block of shackel by the weight of person descending, such pressure being increased or diminished by holding the end of the rope hanging down more or less firmly with one hand.

IMPROVEMENTS IN TELEGRAPH POSTS.—Mr. A. Muirhead, D.Sc., of Westminster, has patented improvements in telegraph posts. This invention is applicable especially to posts which are built up of several lengths or tubes. Each tube is made either of circular or oval form in transverse section, and in the lower end of the tube is inserted a strengthening or stiffening piece, which consists essentially of a plate or web, which, when the stiffening piece is properly inserted in the post, extends vertically within the same and diametrically across the interior thereof in a plane parallel to the telegraph wire, that is to say, it occupies such a position that it will offer the maximum resistance to the bending stresses which the post has to withstand. The vertical plate is provided with one or more plates at right angles thereto, which fit into the tube, and prevent the liability to failure of the post by collapse.

DISTILLING APPARATUS FOR SHIPS.—An apparatus for obtaining fresh water for ships' use has been patented by Mr. H. Dansey, of Gracechurch-street, London. This invention consists in an apparatus for obtaining fresh water, in which the waste gases escaping from the ships' boiler furnace are utilised to effect the evaporation of sea water while in a partial vacuum. The apparatus comprises a vertical tube fitted in the smoke-box, or funnel, of the ship's boiler. The tank having been supplied with the necessary quantity of water, and communication opened between the vertical tube and the condenser, the water in the tank will be caused to rise in the vertical tube to a certain height by reason of the vacuum and atmosphere pressure, and will become heated and evaporated by the heat from the waste gases passing up the funnel. The water being in partial vacuum the evaporation takes place at a low temperature and rapid rate. The steam passes to the condenser and is condensed.

ELECTRICAL CONTACT MAKER.—An apparatus for making and breaking electrical circuits has been patented by Messrs. Sudworth and Falkenstein, of South Hackney, London. The object of the invention is to ensure a simultaneous breaking of the circuit at a number of distinct points, so as to ensure a minimum of sparkling and consequent reduction of wear and tear of the working parts. The apparatus consists of a suitably-formed base of insulating material, on which, in the case of a two-pole switch, the four electrically separate contact pieces are rigidly mounted; the latter are so disposed and placed in pairs on the base as to admit of a passage between each pair of them of a lever by which the circuit between the two is completed or broken as required. When in their normal position the levers are out of contact with the pairs of contact pieces and the circuit is broken in two places. The levers are constructed from any suitable insulating material, and have at the ends metallic pieces, which, when forced into or between the pairs of contact pieces, complete the circuit between them.

ANNOUNCEMENTS.

KING'S COLLEGE.—Mr. John M. Thomson has been appointed to the Chair of Chemistry in King's College, vacant through the death of Prof. Bloxam.

GEOGRAPHICAL MUSEUM.—The Council of the Royal Geographical Society are arranging a small select and permanent museum of appliances used in geographical education, consisting, in the first place, of some of the best things shown at the recent public exhibition.

GEOGRAPHY IN ELEMENTARY SCHOOLS.—The Education Department has accepted the offer of the Royal Geographical Society for prizes in money (two of £15 each) and books to be awarded for the results of special training college examinations held for the encouragement of geography in elementary schools.

THE CENTRAL INSTITUTION.—Dr. A. K. Miller, Demonstrator and Assistant in the Chemical Research Laboratory, will deliver, during the spring term, a course of ten lectures on the chemistry of oils and fats. The course will be delivered on Mondays at 4 p.m., and will begin on January 23rd, 1888.

THE IRON AND STEEL INSTITUTE.—As a result of the ballot of members just taken, the Council of the Iron and Steel Institute have decided to accept the invitation given by the American iron and steel masters at the Manchester meeting in September last to hold the next autumnal meeting of the Institute in the United States. Two hundred and fifty members have promised to attend the meeting. The date has not yet been fixed, but it will probably be in September.

OXFORD PROFESSORSHIP OF GEOLOGY.—Candidates are requested to send to the Registrar of the University, on or before February 1st, 1888, their applications, accompanied by any such evidence of their qualifications as they may desire to submit to the electors. The professor is to receive £400 per annum, to be augmented, when the revenues of the University permit it, to a sum not less than £700. He is to reside four months of the academical year, and to lecture in two of the three University terms.

DIARY FOR NEXT WEEK.

Monday, Jan. 16.—London Institution, at 5 p.m.—*The Ancient Eastern Empires;* Rev. William Benham, B.D.
Society of Arts, Foreign and Colonial Section, at 8 p.m.—*The Colonies and Dependencies of the Netherlands and of Portugal;* Mr. A. J. R. Trendell.

Tuesday, Jan. 17.—Zoological Society, at 8.30 p.m.—*On the Lepidoptera received from Dr. Emin Pacha,* Mr. A. G. Butler; *The Shells of the Albert Nyanza, Central Africa,* Mr. E. A. Smith; *Description of some New Lepidoptera from Kilima-njaro,* Mr. A. G. Butler; *Notes on a Collection of Mammals obtained by Emin Pacha in Central Africa,* Mr. O. Thomas.
Royal Institution, at 3 p.m.—*Before and After Darwin;* Mr. G. J. Romanes.
Royal Statistical Society, at 7.45 p.m.—*Progress, Organisation, and Aims of Working-Class Co-operators;* Benjamin Jones.

Wednesday, Jan. 18.—Civil and Mechanical Engineers' Society, at 7 p.m.—*Steel Sleepers;* Mr. H. T. Munday.
Cardiff Amateur Photographic Society.—*Demonstration of Photography by Magnesium Light;* Mr. A. Keller.
Society of Arts, at 8 p.m.—*Methods of Taking the Ballot;* three papers, by Messrs. John Leighton, James Withers, and John Imray.

Thursday, Jan. 19.—London Institution, at 6 p.m.—*The Material of Music;* Mr. W. A. Barrett, Mus.Bac., Oxon.
Royal Institution, at 3 p.m.—*The Walker School;* Mr. H. Herkomer.
Chemical Society, at 8 p.m.
Royal Society, at 4.30 p.m.
Camera Club, at 8 p.m.—*Lecture,* by Capt. W. de W. Abney, R.E.

Friday, Jan. 20.—Royal Institution, at 9 p.m.—*Diffraction of Sound;* Lord Rayleigh.
Camera Club, at 8 p.m.—*Lecture on Photography,* by Mr. Lyonel Clark.
Royal United Service Institution, at 3 p.m.—*The Principles that Govern the Handling of the Artillery of an Army Corps;* Capt. R. F. Johnson, R.A.
British Museum, at 2.30 p.m.—*The Hittites;* Mr. T. Tyler.

Saturday, Jan. 21.—Royal Institution, at 3 p.m.—*Experimental Optics;* Lord Rayleigh.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

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"Practical Amateur Photography," third thousand, ready January 14th, 58 pages, photographic frontispiece, set gummed chemical labels; 7d. stamps.—VEVERS.

Photographic Apparatus.—Complete sets from 17s. 6d. "Optimus" Lenses 10 per cent. discount. Illustrated list free.—C. C. VEVERS, Horsforth, Leeds.

Horizontal Slide Valve Engine, only twice used, 30s. Good Microscope, nearly new, 55s. See Exchange column.—BUTLER.

Castings, Parts, Materials, and Finished Models. Catalogue, 2d.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

"Playground of Science," just ready, containing novel, simple, and interesting scientific experiments, illustrated. One Shilling, post free.—TRUSLOVE AND SHIRLEY, 7, St. Paul's-churchyard, London.

Magnesium Lamp, 6d.; postage, 3d.; Magnesium, 2d. yard. List free.—HUMPHRIES, 29, Grafton-road, Holloway, London.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

BOOKS RECEIVED.

General Electric Apparatus Co. Catalogue.—"A B C Guide to Autotype," J. R. Sawyer (Autotype Co.).—"Elektrische Appraate Maschinen und Einrichtungen," W. E. Fein (J. Hoffmann, Stuttgart).—"Other Suns than Ours," R. A. Proctor (Allen).—"Lectures on Bacteria," A. De Bary (Oxford Clarendon Press).—"Unfinished Worlds," Parkes (Hodder and Stoughton).—"Sketch of the Geological History of the Earth," E. Hull (C. W. Deacon and Co.).

Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

THE PROPOSED ALBERT UNIVERSITY.—The want of a real university for London which shall be a teaching body and what is still more important, a school for research in the various sciences, becomes from day to day more distinctly felt. The present London University, as a mere examining and degree-conferring body, is something perfectly unique, and however ably it may have discharged its limited functions, its foundation must be considered as a step in a doubtful direction, springing from a misconception of what was at that time the weak side of British universities. If we remember that the incorporation of the Victoria University of Manchester met with zealous opposition, we may expect that the proposed Albert University will encounter not a few storms before it receives a Royal charter.

THE "CROSS" POISONING CASE.—This case and the attempt made to throw discredit on the analysis of Dr. Yelverton Pearson reminds us of the unsatisfactory manner pursued by our Courts in obtaining the evidence of physicians, chemists, engineers, microscopists, etc. It is desirable that experts should not be "called" by one side or the other, but should be appointed for the time being as assessors, as required, to instruct the Court on the scientific questions involved, just as does the judge on the points of law. In the present case Dr. Pearson was obliged to say that he had never previously made a toxicological analysis on the human subject, but he was not allowed to add that he had made numerous examinations of the viscera of lower animals in cases of death from poisoning. The present system of examination and cross-examination is admirably adapted to ensure the suppression of any truth which counsel on either side may deem will tell against his client.

THE EXTENSION OF THE TELEPHONE.—The recent extension of the telephone proves that, in some countries at least, it must meet a want which has been distinctly felt. The increase in the number of telephone wires has, according to the *Electrical Review*, been in Switzerland at the rate of 1,700 per cent.; in Germany 333 per cent.; in Austria 267 per cent.; in Russia 233 per cent.; Sweden 200 per cent.; Belgium and Holland 50 per cent.; Italy 23 per cent.; Great Britain 19 per cent.; and France 11 per cent.

The increase in the number of subscribers has been mainly proportionate. It has been greatest in Switzerland, 486 per cent., and smallest in France and Italy, where the numbers of subscribers have been respectively augmented by 62 and 52 per cent. Great Britain has still the largest number of telephone users, 15,114, and Austria the smallest, 3,032.

THE REFORM OF HIGHER EDUCATION.—Professor Silvanus Thompson shows that "the first and most important point of all is to secure the creation of a real Education Department under a real Minister of Education. At present we have no Minister of Education, only a Vice-President of Council, whose duties appear to be extensive and peculiar. They comprise apparently the work of looking after the regulations for statute-fairs and diseases of cattle; of supervising the Elementary Education Department and the Science and Art Department, and

of superintending the proceedings of the Judicial Committee of the Privy Council. What is wanted is a real Minister of Education, presiding over an organisation in which the Elementary Education Department, the Science and Art Department, and the Departments of Secondary (including Technical) and Higher Education, should all take their appropriate places under officials responsible directly to the Minister himself, and not to that mysterious body, "My Lords." No attempt of Parliament to organise technical instruction can be satisfactory unless it involves the appointment of a responsible Minister of Education, and a reconstruction of the whole Departmental policy.

Gold Mining in Wales.—There is at present considerable discussion concerning the gold-mining operations now being conducted by Mr. Pritchard-Morgan at Gwynfynydd in Merionethshire. Some authorities maintain that the gold in the Welsh quartz lodes is "bunchy" or "pocketty," very rich deposits occurring in an isolated manner amidst very poor stuff. The reply is made to this that former explorers were, as far as gold is concerned, mere amateurs, who did not rightly understand how to follow up the indications of the precious metal. The present operations on the contrary are directed by Australian and Californian experts. It must, however, be admitted that much of the gold is not disseminated in the free state among the quartz, and capable of being extracted by the amalgamation process, but exists in the "mineralised" form, complicated with blende, sulphuret of antimony, or other bodies. Hence, without great care and skill much of it may go to waste.

The Planetoids.—The minute planets which revolve round the sun in orbits intermediate between those of Mars and Jupiter furnish astronomers with abundant matter for investigation. Some ten to twelve of these bodies, hitherto unobserved, are detected every year. Professor D. Kirkwood, of the University of Indiana, has recently made a report on the elements of their orbits. But he points out that, theoretically speaking, the total number of these small heavenly bodies may amount to 72,000,000. In a second portion of the report the author discusses the origin of the planetoids, the relations apparent in their orbits, and their irregularity of distribution, a region being left void where such bodies, if existing, would have a period of rotation commensurate with that of Jupiter. Professor Kirkwood suggests that some of the periodic comets may have been originally planetoids. All the thirteen comets whose periods correspond to mean distances within the planetoid zones have direct motions and inclinations like those of the minor planets. The periods of five of these comets, indeed, correspond to some of the best-marked vacancies in the region of the planetoids.

The Bradford Proposals for Technical Education.—The resolutions passed by the Council of the Bradford Technical College, as given in our number for January 6th (p. 21), deserve very careful attention. They are much more reasonable and practical than the proposals of certain indiscreet, if zealous, educationalists, who wish to have all children educated alike in technical subjects. One of the most fatal errors in national education is the attempt to stereotype the minds of the people by forcing one uniform course of training upon all pupils, without reference to the special capacities of each individual, and to the varying requirements of each district. It is perfectly true that the improvement and development of our manufactures can only be expected from the technical training of youths of special ability, and not from the technical education of children n general. It is to be hoped that the Bradford resolutions will be duly considered before any step is taken by Government.

Small-Pox in Sheffield.—It is alleged that in Sheffield the small-pox first appeared in March last, and has since increased very regularly up to December, when there were 800 cases. The death-rate in the town from all causes has not, however, been increased to the degree which might have been expected. The highest weekly death-rate recorded is 29·2 in the thousand. A very creditable device in connection with the epidemic has been adopted in nearly every manufactory in the town. Every workman agrees to pay a certain sum to a general fund, the proceeds serving to pay every one who is either attacked with the disease, or is prevented from going to work through having small-pox in his house. This system works well, and prevents much distress. The experience gained during the course of the epidemic supports the view that vaccination in infancy is an almost complete safeguard up to the age of adolescence, when re-vaccination proves a preventive for the remainder of life.

A Gigantic Fossil Tortoise.—MM. Depéret and Donnezan have discovered an enormous fossil tortoise, *Testudo perpiniana*, in the middle pliocenes of Perpignon. The carapace of the specimen measures four feet in length by thirty-nine inches in breadth, exceeding any fossil species hitherto discovered.

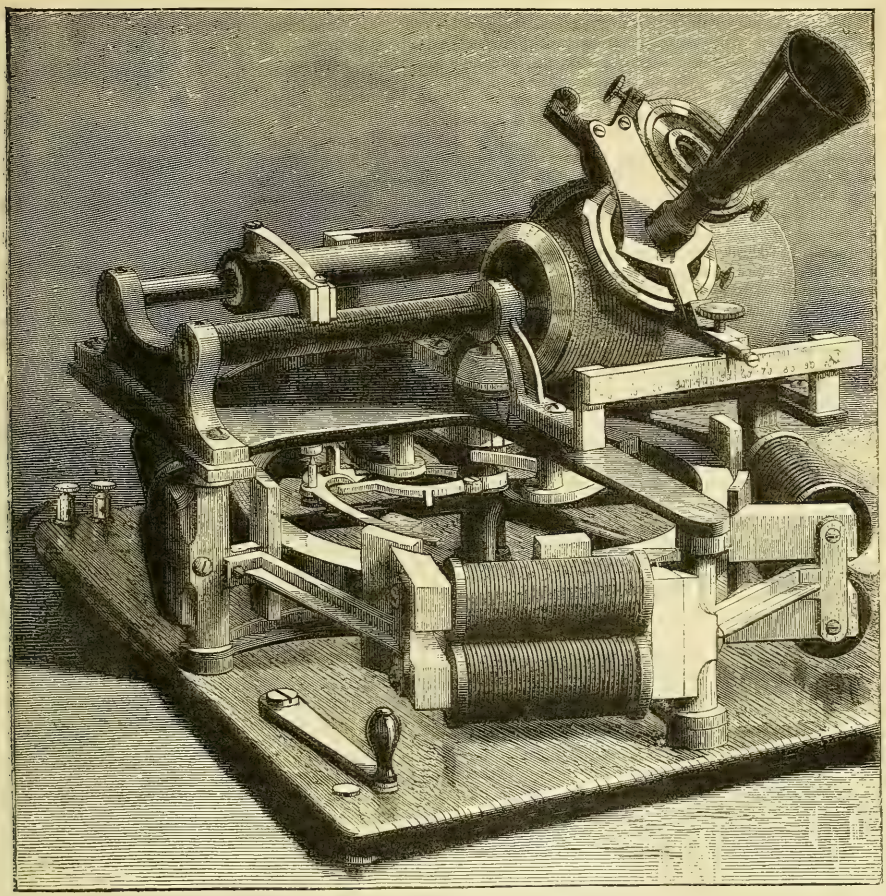
Mean Temperatures.—M. Alexis de Tillo (*Comptes Rendus*) shows that the mean yearly temperature of Africa is 79·5° Fahr.; that of South America, 73·4°; that of Australia (including New Guinea), 72·1°; that of the Indian Ocean, 68·7°; of the Pacific, 67·3°; of the Atlantic, 62·6°; of Asia and Europe, 50°; and of North America only 40·4°.

Expansion of Metals by Heat.—It is not generally known that even in the comparatively cool climate of Britain the rails on railways have been known to expand in consequence of the sun's heat to such an extent as to become warped and twisted. An accident which occurred near Wigan some years back was traced to this cause.

THE EDISON PHONOGRAPH.

THE new phonograph, which forms the subject of our illustration, is of about the size of an ordinary sewing machine. In its construction it is something like a small engine lathe; the main spindle is threaded between its bearings, and is prolonged at one end to receive the hardened wax cylinder upon which the sound record is made. Behind the spindle and the cylinder is a rod upon which is arranged a slide, having at one end an arm adapted to engage the screw of the spindle, and at the opposite end an arm carrying a pivoted head, provided with two diaphragms, whose position may be instantly interchanged when desirable. One of these diaphragms is turned into the position of use when it is desired to talk to the phonograph, and when the speech is to be reproduced, the other diaphragm takes its place.

The device for reproducing the sound consists of a cell containing a delicate diaphragm of gold-beater's skin, to the centre of which is secured a stud connected with a small curved steel wire, one end of which is attached to the diaphragm cell. The spindle of the phonograph is rotated regularly by an electric motor in the base of the machine, which is driven by a current from one or two cells of a battery. The motor is provided with a sensitive governor which causes it to maintain a very uniform speed. Motion is transmitted from the motor to the spindle by bevel friction wheels. The arm which carries the diaphragms is provided with a turning tool for smoothing the wax cylinder preparatory to receiving the sound record. The first operation in the use of the machine is to bring the turning tool into action and cause it to traverse the cylinder. The turning tool is then thrown out, the carriage bearing the diaphragms is returned to the position of starting, the



receiving diaphragm is placed in the position of use, and as the wax cylinder revolves, the diaphragm is vibrated by the sound waves, thus moving the needle so as to cause it to cut into the wax cylinder and produce indentations which correspond to the movements of the diaphragm. After the record is made, the carriage is again returned to the point of starting, the receiving diaphragm is replaced by the speaking diaphragm, and the carriage is again moved forward by the screw, as the cylinder revolves, causing the point of the speaking diaphragm to traverse the path made by the recording needle. As the point of the curved wire attached to the diaphragm follows the indentations of the wax cylinder, the speaking diaphragm is made to vibrate in a manner similar to that of the receiving diaphragm, thereby faithfully reproducing the sounds uttered into the receiving mouthpiece.

A crucial test of the capabilities of this machine was recently made at Mr. Edison's laboratory, near Llewellyn Park, Orange, N.J. A paragraph from a morning newspaper was read to the machine in our absence, and when upon our return to the instrument it was reproduced phonographically, every word was distinctly understood, although the names, localities, and the circumstances mentioned in the article were entirely new and strange to us. Another test of the perfection of the machine was the perfect reproduction of whistling and whispering, all the imperfections of tone, the half-tones, and modulation even, being faithfully reproduced. The perfect performance of the new instrument depends upon its mechanical perfection—upon the regularity of its speed, the susceptibility of the wax cylinder to the impressions of the needle, and to the delicacy of the speaking diaphragm. No attempt is made in this instrument to secure loud speaking—distinct articulation and perfect intonation have been the principal ends sought. The new phonograph is to be used for taking dictation, for taking testimony in court, for reporting speeches, for the reproduction of vocal music, for teaching languages, for correspondence, for civil and military orders, for reading to the sick in hospitals, and for various other purposes too numerous to mention. Imagine a lawyer dictating his brief to one of these little machines; he may talk as rapidly as he chooses; every word and syllable will be caught upon the delicate wax cylinder; and, after his brief is complete, he may transfer the wax cylinder to the phonograph of a copyist, who may listen to the words of the phonograph and write out the manuscript. The instrument may be stopped and started at pleasure, and if any portion of the speech is not understood by the transcriber, it may be repeated as often as necessary.

In a similar manner a compositor may set his type directly from the dictation of the machine without the necessity of "copy," as it is now known. Mr. Edison informs us that the whole of "Nicholas Nickleby" could be recorded upon four cylinders, each 4 in. in diameter and 8 in. long, so that one of these instruments in a private circle, or in a hospital, could be made to read a book to a number of persons. This is accomplished by means of a multiple earpiece.

The little wax cylinders upon which the record is made are provided with a rigid backing, and the cylinders are made in different lengths, the shortest—1 in. long—having a capacity of 200 words, the next in size 400 words, and so on. These cylinders are very light, and a postal-case has been devised which will admit of forwarding the cylinders as readily as letters are now posted. The recipient of the cylinder will place it on his own phonograph and listen to the phonogram, in which he will not only get the sense of the words of the sender, but will recognise his expression, which will, of course, have much to do with the interpretation of the true meaning of the sender of the phonogram.

A very interesting and popular use of the phonograph will be the distribution of the songs of great singers, sermons, and speeches, the words of great men and women, music of many parts, the voices of animals, etc., so that the owner of a phonograph may enjoy these things with little expense.

It may even be pressed into the detective service, and used as an unimpeachable witness. It will have but one story to tell, and cross-examination cannot confuse it. Extensive preparations for the manufacture of the phonograph have been made, and it is probable that within a short time these instruments will be as common and as indispensable as the sewing-machine or the typewriter.—*Scientific American.*

THE BACTERIOLOGICAL WATER-TEST.

DR. G. BISCHOF, F.C.S., has recently communicated to the Royal Society the results of an extensive series of experiments on this subject.

His researches, which have been performed with special reference to that vexed question, the metropolitan water supply, lead him to the following conclusions:—

No bacteriological water-test can satisfy the demands of hygiene unless it is qualitative, distinguishing between harmless and pathogenic microphytes. No such test is at present known.

Merely numerical results without such distinction are entirely unintelligible, unless the time and other conditions of culture of each test be specified.

A small portion only of the "colonies" capable of growing in gelatine-peptone is indicated by three days' culture. The ratio of "colonies" thus indicated by three days' culture to that of the total present appears to differ so widely in *different* samples that the number of colonies obtained from them cannot be compared with each other.

Instead of attempting any such comparison, the changes taking place from time to time should be followed up in each sample separately.

Extension of culture beyond three days increases the trustworthiness of the results; how far this holds good, and how far culture should be extended, we have at present not sufficient evidence to show.

The usefulness of results is probably still further increased by combination and extension of culture with storage in sterilised flasks for a certain time. As regards the control of the working of sand-filtration at waterworks, *any* bacteriological test, to be of practical utility, should be repeated at intervals certainly not exceeding a fortnight. It is desirable for the purpose of such control to test the water entering and leaving each filter.

ELECTRIC MICROSCOPE.—We learn that Professor Waldeyer, of Berlin, is having an electric microscope constructed in Vienna for electric light demonstrations. We presume this instrument is to take the place once occupied by the solar microscope.

WILL MEN EVER FLY?—I.

WILL men ever fly?

That is a question which has attracted the attention of mankind for countless ages past, and would yet seem as far as ever from receiving an affirmative answer. We have constructed balloons, and risen to heights at which existence can with difficulty be maintained. But that, of course, is not flying at all; neither would be our passage through the air by mechanical agency. And we have striven, but always in vain, to adapt wings, or modifications of wings, to the human frame.

For, in all attempts of the latter class, the immense difference between the human structure and that of flying animals appears to have been consistently ignored. Experimentalists have gone to work as though the one and only requisite were the possession of wings, altogether forgetting that almost every detail of almost every part of the frame must be altered before those wings could be employed with any chance of success. The lungs must be greatly enlarged, the muscular system greatly strengthened, the skeleton greatly modified, the weight greatly diminished, the bodily balance completely changed. Could man literally and actually fly, he would be man, physically speaking, no longer, but would differ from the human type at least as greatly as does the bat or the bird. And thus it is that his attempts to furnish himself with artificial wings are ever doomed to failure.

Let us glance at the structure of the three classes of beings—bats, birds, and insects—to which the power of flight has been granted, passing by such creatures as the flying squirrel, the flying dragon, and the flying fish, which merely skim for limited distances through the air, but do not really fly at all. By this means we shall gain some idea of the alterations which would be necessary in our own frame before we could acquire the enviable faculty in question.

First, then, as to the bats.

These are creatures whose powers of flight, albeit amply sufficient for their wants, are not of a very remarkable character; they lack both the speed and the endurance which characterize so many birds and insects. But the extensive modification which is yet visible in their frames when compared with those of their nearest allies, the monkeys, is yet amply sufficient to show us how hopelessly impossible it is that man should ever fly at all.

I pass by the question of the wings themselves altogether. These, in man, would naturally be represented by artificial substitutes, and thus the complete transformation of his arms into organs of flight would not be required. But the muscular system in connection with those limbs, and the bony framework of the shoulders and the chest, would necessarily be greatly changed. So we find in our bat. The shoulder-blades, in the first place, as shown in Fig. 1, are large and broad, and are traversed by a deep "keel," for the better attachment of the powerful wing-muscles. The breast-bone, too, is almost disproportionately large and stout, and is keeled in precisely the same manner, while the collar-bone and the ribs are also very strongly and solidly built. The hinder portions of the skeleton, however, upon which the strain of the wing-muscles is not thrown, are strikingly slender and dwarfed, every particle of unnecessary material being removed in order to reduce the weight to the lowest possible degree.

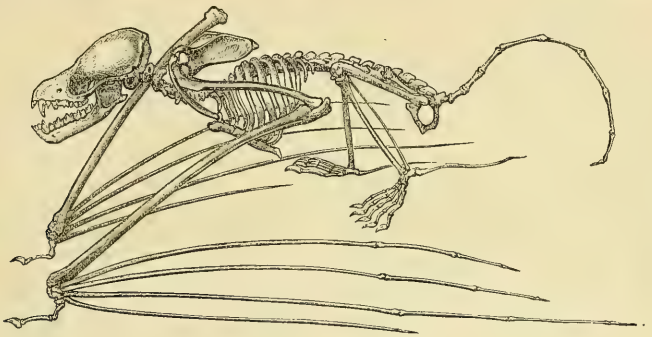


FIG. 1. SKELETON OF A BAT.

So with the muscles. Those in the anterior portion are stout and strong, those in the posterior are small and feeble. Power of flight is the paramount necessity, and so to that all else gives way.

Some kind of a rudder is necessary, for wings alone would be of but little use for purposes of steerage; and so the wing membrane is brought round behind the body, and supported by the bone of the tail. Further support, however, is required, and so a long and slender bony spur, so to speak, runs from either heel, passes between the upper and lower layers of the wing-membrane, and affords the necessary rigidity.

The lungs, as is only to be expected, occupy a very considerable space, for rapid aerial motion implies a correspondingly rapid consumption of oxygen, and a consequent increase in the extent of vascular surface by means of which the blood is cleansed and vivified. Large lungs, as a necessary corollary, lead to a large circulatory system; and that of the bat is developed in a very striking degree. Finally, the position of the body, during flight, is parallel, or nearly so, with the plane of the earth's surface.

(*To be continued.*)

OIL ON THE TROUBLED WATERS.

FOR centuries these words have been used in a figurative sense, with little thought concerning their origin. Yet surely, unless oil had at some time or other been found to have the effect of calming disturbed waters, no such expression could ever have arisen. But though the proverb survived, the use of oil in this sense was forgotten, and when in quite recent days it was first asserted that the fury of the sea might be greatly moderated by this means, the announcement was received with incredulity, or even with contempt.

Yet a natural phenomenon, not unknown to sea-faring men, might have sufficed to draw attention to the calming effects of oil half a century ago. Along the Malabar coast there is a certain tract where the water is always remarkably tranquil, even during strong south-westerly monsoons. The sea shows a kind of oily scum, which, as it has been ascertained, is derived from springs of petroleum at the bottom, and which prevents the formation of breakers.

Incredulous as many persons might prove, the appeal to experiment was duly made. The trials on ponds and lakes in rough weather succeeded; the waves were rendered flatter, and ceased to break and fall over as they came in contact with the shore. Still, that any such trifling agency could prove successful on the ocean seemed very doubtful. But here, also, the trial was made by captains of ships on encountering dangerous storms, and the results were encouraging beyond all expectation. Paragraphs notifying the success of these experiments went the round of the papers, and public attention was thoroughly excited. The Hydrographic Office at Washington made a collection of duly authenticated cases of the use of oil, and finally Vice-Admiral Cloué, of the French navy, gave in a formal report on the subject to the Paris Academy of Sciences. From this report we shall extract a few facts which are most characteristic of this newly-discovered, or rather, re-discovered method of saving life and property at sea.

The arrangement for the diffusion of oil, as commonly adopted on board ship, consists of a bag of strong sail-cloth large enough to hold about two gallons, and filled with tow well soaked in oil. More oil is poured upon the tow, the bag is sown up, and its bottom is pierced with several holes made with a sail-maker's needle. When sailing before the wind one such bag is suspended at each angle of the stern and allowed to trail in the water. Another bag is fixed a little forward on each side.

The effects of this simple process are allowed to be surprising. All the numerous reports collected agree that the oil diffuses itself over the water with extreme rapidity, and that, even when the waves previously seemed ready to swallow the ship, there at once appears a broad tract of smooth water, within which all breakers are suppressed.

Among the most decisive cases of ships which have been saved in this manner may be mentioned that of the *Stockholm City*, which, on its passage from Boston to London, encountered a terrible westerly gale, raising the waves to an enormous height. The ship was loaded above her water lines, and the deck being encumbered with two hundred head of horned cattle, it was found impracticable to bring her head to the wind. The only resource was to drive before it, but this manœuvre became exceedingly hazardous. The captain, therefore, resolved to make use of oil. A bag, filled as has already been described, was suspended at each angle of the stern, two others were placed amidships, and others at the bows. The action upon the waves is reported as instantaneous; the most dangerous breakers were converted into a harmless swell, and whilst thus driving for about one hundred and seventy miles before the storm, not a sea was shipped.

A second instructive case is that recounted by Captain Bailey, of the *Nehemiah Gibson*. Foreseeing a hurricane whilst sailing with the wind astern, and with a heavy sea which became constantly more violent, he took two sail-cloth bags, each holding half a gallon, pierced with holes and filled with porpoise oil. The bags were suspended so as to dip in the water, and the oil produced the desired effect. The huge waves which rushed into the ship's wake with their breaking and dangerous crests, and which, rising much higher than the vessel, threatened to overwhelm her, were suddenly pacified as they reached the tract of smooth water produced by the oil. Their crests disappeared and they passed harmlessly under the keel. No fewer than eighty-one such cases of ships driving before the wind have been reported.

Seventy-two successful cases are also on record where vessels have encountered a head-wind. Captain Rollin, of the *Emily Whitney*, in a violent storm on August 25th, 1886, having made use of oil, found the sea rendered smooth to a distance of fifty yards around the ship.

Perhaps the value of this method appears most signally in cases where it becomes necessary to rescue the crew of a vessel in distress. For some years already the life-boats on the Australian coasts have succeeded in crossing the reefs in bad weather by dint of diffusing oil. This they do without incurring any danger and without shipping a drop of water. The oil forms amidst the breakers a smooth track, on each side of which the waves roll over with violence. Crews have been saved out at sea during storms by very small vessels without any danger; the two ships lying to as close to each other as possible, when oil diffused by the one to windward formed between them a broad, smooth track, offering perfect security for the boats. Several vessels loaded with the crews of other ships which had foundered or had been destroyed by fire, owe their safety entirely to the use of oil, of which there was fortunately a supply on board.

Captain Greenbank, of the *Martha Cobb*, sailing from Newfoundland to Europe, rescued by this means the crew of a vessel about to founder. His own cargo was petroleum, and as some of the casks leaked considerably he was able to smooth the sea by merely working his pumps. Bringing his ship as near as possible to the wreck, he was able to carry off the crew in safety in a very small boat, which would otherwise have been instantly swamped. He considers that in any tempest or heavy sea persons may be safely conveyed in boats from one vessel to another, provided the one to the windward makes a judicious use of oil.

The best oils for the purpose are those of the seal and the porpoise. Mineral oils have been used with success, but they are too light. Certain vegetable oils, such as that of the cocoa-nut, congeal too quickly in cold seas. The hourly consumption of oil for this purpose need not exceed half a gallon.

The only remaining question is whether the lesson thus learnt is to be turned to practical account, or whether, like too much of our knowledge, it is to be neglected.

GENERAL NOTES.

Mineral Wax in Galicia.—An important and beautiful deposit of mineral wax has been discovered at Sloboda Rungorska, in Austrian Galicia. It is supposed to overlie petroleum.

Phenol in Perspiration.—Herr A. Kast (*Zeitschrift fur Physiologische Chemie*) has detected in human perspiration minute quantities of phenol, the principal constituent of commercial carbolic acid.

The Purification of Anthracene.—A chemical company at Hamburg propose to purify anthracene by dissolving it in hot aniline. On cooling the anthracene is deposited, but not the accompanying impurities, which remain in solution.

A Mammoth's Head at Montmartre.—In digging the foundations for a viaduct over Montmartre Cemetery a mammoth's head was discovered. The tusks were nearly two feet apart. A search will be made for the rest of the body.

Temperature of the Sun.—Messrs. Trowbridge and Hutchins, in the *American Journal of Science*, conclude that in the region of the solar atmosphere, where carbon is volatilised, the temperature of the sun is equal to that of a voltaic arc.

The Recently Discovered Elements.—Mr. J. H. Bailey, of the Owens College, writing in the *Berichte* of the German Chemical Society, points out certain considerations which render the supposed new elements of H. H. Krüss and Nilson for the present doubtful.

Potassium Cyanide Vapour.—It is a mistake to suppose that the vapours given off by potassium cyanide are deadly to all animals. We have seen several species of beetles which after prolonged imprisonment along with abundance of this chemical came out quite safe and sound.

Sanitary Neglect.—According to a medical contemporary, at a large boarding-school near Lyon, 119 out of the total 235 inmates fell victims to typhoid fever. A badly-constructed sewer had been allowed to pass within five yards of the well which supplied the establishment with water.

Copper Poisoning.—Cases of poisoning with copper are decidedly uncommon. A wedding-party at Great Houghton, in Northamptonshire, suffered rather severely from drinking tea made in an old copper urn. No deaths have occurred, but some of the twenty-two sufferers are still seriously ill.

The Late "Challenger" Expedition.—According to a current report, the total cost of compiling and publishing the reports of this Expedition, the last three volumes of which are about to appear, has already exceeded £200,000. We fear that much of this money has been spent in what can only by an extreme stretch of courtesy be counted as scientific work.

The Cancer Germ.—It has been announced in the *Kreuz-Zeitung* that Dr. Scheuerlein, an assistant in the Clinical Department of the Charité Hospital at Berlin, discovered lately an ovoid microbe, which he considers to be the cause of cancer. It is not, strictly speaking, a bacillus, and the experiments performed in proof of its supposed function have not led to any decisive results.

Use of the Magnet in Paper Manufacture.—According to the *Papier Zeitung*, the minute specks of iron abraded from the machines used in making paper pulp, may be removed by placing steel magnets made in the shape of a comb in the stream of pulp and water which issues from the machine. In this way the annoyance caused by the minute particles subsequently producing, on exposure to the air, spots in the finished paper may be prevented.

The Compound Nature of Magnesium and Carbon.—At the December meeting of the Vienna Academy of Sciences, Professor Gruenwald, of Prague, sent in a communication on the "Mathematico-spectroscopic Analysis of Magnesium and Carbon." It treats of the discovery of the compound nature of these bodies, which have hitherto been supposed elementary or simple, and gives the accurate characteristics of their primary components.

A Newly-Discovered Island.—The Government of Batavia has given notice to the Admiralty that the Commander of His Netherlands Majesty's ship *Samarang* reports the existence of a low, wooded island, hitherto uncharted, lying westward of Selaru, Timor Laut Islands. The island is reported to be about two miles long, in a north-north-easterly and south-south-westerly direction, and about two-thirds of a mile broad. Position as given, centre of island (approximate), lat. 8° 15′ S., long. 130° 39′ E.

Silver in Volcanic Ashes.—Professor J. W. Mallet, of the University of Virginia, has discovered silver in the ashes thrown out by the well-known Mexican volcano, Cotopaxi. The sample analysed had been collected at a spot near the Pacific Coast, and at the distance of 120 miles from the mountain, yet even there it lay several inches deep. The silver was only 0·0012 parts in 100 parts of the ashes, but if their enormous quantity is considered, even this fraction represents a great value. Silver has not previously been detected among volcanic products.

The Gold Deposits of Peru.—The numerous veins of gold in Peru traverse not merely the crystalline granite and syenitic rocks of the coast, but also the sedimentary formations, including the metamorphic rocks as well as the quartzites. As usual the gold veins are essentially quartzous. In those of the first deposit the gold is accompanied with compact or micaceous oligiste, limonite, and a talc-like substance. In the other strata it is associated with pyrites and other metallic sulphurets, containing more or less silver, such as chalkopyrite, panabase, bournonite, jamesonite, and galena.

Electric Conductivity of Woods.—Certain experiments, instituted by the "United Telephone Company,"

give the following results as to the resistance of the subjoined species of wood to electric currents passed along the fibre:

Mahogany	40 meg. ohms.
Pine	214 „
Rosewood	291 „
Beech	397 „
Oak	478 „
Teak	734 „

If the direction of the current is transverse to the fibres the resistances are increased from 50 to 100 per cent.

Influence of the Moon on the Barometer.—M. A. Poincaré has recently presented a note to the French Academy of Sciences, in which he has drawn attention to the variations in the height of the barometer with the phases of the moon. He has considered the data for the year 1883 for the parallels 40° and 10° north, and has shown that there appears to be some relationship between the atmospheric pressures in these two latitudes and the varying positions of the moon. Should he be able, from the determinations of barometric pressure, to generalise some law connecting these phenomena, we may hail this fact as a valuable contribution to our present knowledge of meteorology.

Carbons for Electric Lighting.—As an indication of the great development of electric lighting in the United States, it is stated that there are 150,000 carbons used daily in that country, and that 100,000 are manufactured at Cleveland, where there are twenty furnaces. The carbons are made from the residua of petroleum distillation, as well as from the carbonaceous deposits found around natural gas wells. The materials are finely pulverised, mixed with a little pitch, and placed in moulds, which are packed in boxes and put into a furnace, where they are submitted to an intense heat for five days. One furnace holds about 45,000 carbons, and two furnaces are constructed side by side, so that one can be charged while the other is being heated.

The Manufacture of Starch.—In addition to the manufacture of spirits and sugar, an important industry which is rapidly increasing in the eastern provinces of Germany is the production of potato starch. In 1883 the production of starch in the province of Posen amounted to 11,000 tons; in 1884, to 12,500 tons; in 1885, to 19,000 tons; and in 1886, to 23,500 tons; showing an increase of over 100 per cent. in a very short period. The greater portion of the starch is exported *viâ* Stettin, and large quantities are also sent to works in the province of Brandenburg. At present consignments of starch to the western districts of Germany are prevented by the high railway tariffs, and were these reduced it would allow of a still further development of the industry.

Sinking Shafts in Wet Sand.—M. Alexandre, of the Houssu Company, in Belgium, is sinking a mine shaft through a stratum of moist sand 12 metres thick, met with at 70 metres depth, by the Poetsch method of freezing the sand and then excavating it like rock. Ten iron tubes (with cutting crown) have been inserted in the sand at intervals of about 1 metre, penetrating the coal below. Into these are put other tubes, through which is passed a solution of chloride of magnesium, cooled by the ammonia freezing process to a temperature of 14° C. The sand is frozen more than 3 metres round the tubes. It has the appearance of a rock harder than the compact chalk of the English Channel tunnel; it is sparkling, and speckled with particles of coal. In making a tunnel recently at a small depth under part of the city of Stockholm, this method was employed with great success. —*Annales Industrielles.*

Influence of Sugar upon Cement.—The results of some experiments made by Mr. Parsons on the influence of sugar on both natural and manufactured cements were given in a paper which he read before the recent meeting of the American Society of Mechanical Engineers. The tests carried out by him were made to conform to the system recommended by the committee of the American Society of Civil Engineers. The machine used was a Riehle Brothers standard cement tester, the form of the mould and the shape of the jaws being those adopted by the above committee. Mr. Parsons found that the reason why sugar gives increased strength to the cement is more mechanical than chemical. That is to say, the sugar, by its presence in the briquette, appears simply to retard the setting of the cement, and thereby permits the chemical changes in the cement to take place more perfectly. He added that the addition of sugar gave an increased efficiency of about 15 per cent.

Structure of Muscle.—The "Structure of Muscle," one of the most difficult questions in histological research, is the subject of an essay by Mr. C. F. Marshall, of Owens College, who gives the following summary of his researches. In all muscles which have to perform rapid and frequent movements, a certain portion of the muscle is differentiated to perform the function of contraction, and this portion takes on the form of a very regular and highly specialised intra-cellular network. This network, by its regular arrangement, gives rise to certain optical effects, which cause the peculiar appearances of striped muscle. The contraction of the striped muscle fibre is probably caused by the active contraction of the longitudinal fibrils of the intra-cellular network; the transverse networks appear to be passively elastic, and by their elastic rebound cause the muscle to rapidly resume its relaxed condition when the longitudinal fibrils have ceased to contract; they are possibly also paths for the nervous impulse. In some cases where muscle has hitherto been described as striped but gives no appearance of the network on treatment with the gold and other methods, the apparent striation is due to optical effects caused by a corrugated outline in the fibre. In muscles which do not perform rapid movements, but whose contraction is comparatively slow and peristaltic in nature, this peculiar network is not developed. In most, if not all, of the invertebrate unstriped muscle there does not appear to be an intra-cellular network in any form, but in the vertebrate unstriped muscle a network is present in the form of longitudinal fibrils only. This possibly represents a form of network intermediate between the typical irregular intra-cellular network of other cells and the highly-modified network of striped muscle. The cardiac muscle-cells contain a network simiar to that of ordinary striped muscle.—*Lancet.*

TOTAL ECLIPSE OF THE MOON.

THERE will be a total eclipse of the moon on the evening of Saturday, the 28th inst., visible from our hemisphere. Lunar eclipses can only take place when the moon is near the spot where her orbit seems to intersect the sun's apparent path in the heaven. On this occasion the middle of the eclipse will occur only a few minutes before the moon is at this point, known as her node, so the eclipse will be practically a central one, and consequently one of long duration.

The phenomena of a lunar eclipse can be best explained by means of the accompanying diagram, where S represents the sun and E the earth. The rays AB CD, coming from the sun, and touching the earth at the points B and D, cast a shadow of the earth in the form of a cone, B F D, which has its apex at a point, F, somewhere in space. Other beams coming from the same points on the sun's surface, AD CB, also cast a shadow contained within the lines B G and D H, thus forming a partially illuminated fringe round the central cone, which is known as the penumbra, the central shadow being termed the umbra.

The moon will enter the penumbra at 8.19 p.m., at 10.31 it will meet the earth's shadow, will be central at 11.20, will quit the shadow at 12.9, and be clear of the penumbra at 2.11 a.m. on Sunday morning. The phenomena attending a total eclipse of the moon are by no means so striking as those accompanying a total eclipse of the sun, but yet there are several points worthy of careful observation.

In 1877 at mid-eclipse the moon was of a beautiful copper-red colour, but at the last eclipse visible in England the moon was nearly invisible. On that occasion, according to some observers, a bright blue rim to the shadow was noticed a little before and a little after totality. During totality the small amount of light that was visible was of a greenish tint, but the form of the moon could hardly be made out. Other observers noticed curious changes in the depths of the shadows during the total phase. A total eclipse of the moon also gives a good opportunity for observing the occultations of small stars, as, owing to the absence of moonlight, the observations can be made with great accuracy.

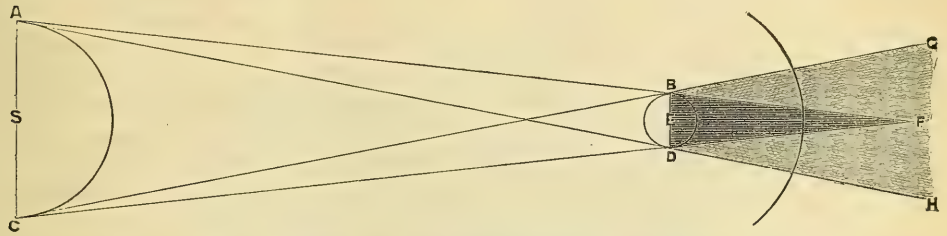


DIAGRAM SHOWING THE FORMATION OF THE UMBRA AND PENUMBRA.

THE NEW CHROMOMICTOR.—II.

MR. AITKEN mentions a very beautiful experiment which can be made with his new apparatus. This may be interesting to our readers. If, after having adjusted the colours to produce white, dull black screens be slipped on the two interior sides of the box, and an opaque body be introduced into the lower compartment, there is at once formed a striking display of prismatic-like colours. The paper on the bottom of the box is no longer white, but covered with most varied and brilliant hues, caused by the penumbra of the opaque body being lighted with different colours on the different sides. Perhaps the most beautiful effects are produced when the shadow-producing body is in the shape of a flat ring, placed a short distance from the bottom of the

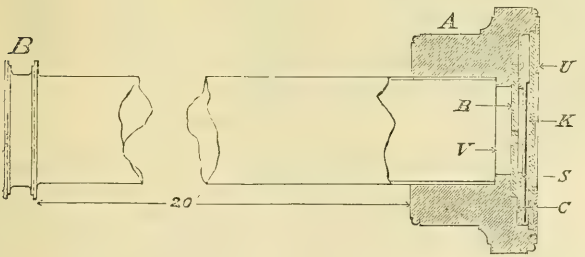


FIG. 3. SECTIONAL VIEW OF CHRONOMICTOR.

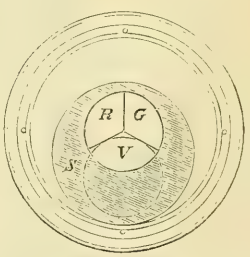


FIG. 4. END VIEW.

box. With that form, the manner in which the different colours are got is easily followed. Confining the attention, by looking through the two eye-pieces, to the light passing through the centre of the ring, three overlapping circles of light can be easily distinguished on the bottom of the box—one red, another green, and the third violet. Where the red and green overlap, a brilliant yellow is produced. Where the green and the violet overlap is a brilliant blue. Where the red and the violet overlap, purple is produced. And in the centre, where all the three circles of red, green, and violet overlap, pure white is produced.

For those who in their experiments do not require to have such rigidly fine results, Mr. Aitken has designed a much simpler instrument, represented in Figs. 3 and 4, of which Mr. Aitken has kindly sent us the drawing. This illustrates the production of an infinite variety of colours from the three primary colours—red, green, and violet; but it has the disadvantage that its working is not under control. As before, B is the eye-piece fixed to the end of a brass tube about twenty inches in length; to the other end of the tube is fixed a circular piece of wood (A), on which is mounted the three coloured glasses (R G V). Fig. 3 represents the vertical longitudinal section of the instrument, and Fig. 4 the end of it. C is a brass plate, with an opening in the centre for holding the glasses in their places. S is a circular blackened disc, with an opening cut excentrically in it, which performs the functions of the shutters in the other instrument. K is a piece of ground glass, and U is a brass ring for holding the glass in its place; these are both removed in the end view of the instrument. The opening in S is carefully adjusted in size and position; when the disc rests in the position shown, then all three glasses are exposed, and a disc of light, the resultant of the three colours, is seen through B. Now suppose this opening is turned to where it is shown in dotted lines, then only violet light will get through it, and only a disc of violet light will be seen. In using this instrument, it is held up to the light and turned round its axis; when this is done, the revolving shutter (S) rolls round in its cavity, and as it rolls, it varies the amount and colour of the light received by B. In one position it allows light of only one colour to enter; in another it allows light of all the colours to pass, and that in ever-varying proportions. When the opening in the screen is at its extreme of excentricity, it may allow light of only one kind to enter, or it may allow light of only two kinds to be combined in endless proportions; and when it rolls from its position of extreme excentricity to that of concentricity, the three colours are combined in unlimited variety. Such an arrangement of three pieces of glass with the three primary colours most ingeniously produces all the possible shades and tints of colours that are known; and the beauty of it lies in the simplicity of its construction. It possesses all the charm of an ingenious toy, while it produces scientific results only attainable by complicated and expensive instruments.

Colour experiments made with these chromomictors explain why there is so little appearance of coloured light in our cathedrals, even when there is much coloured light entering through the stained glass windows; and they show that, though the windows be glazed with the most brilliantly-coloured glass, yet the light in the interior might be quite white. Such apparatus as these will be found eminently useful for teaching physical optics, for experiments on colour perception, and for measuring the qualities of lights from different sources.

ACTION OF OILS ON METALS.

ACCORDING to the *American Journal of Railway Appliances*, a series of experiments, which lasted over twelve months, was carried out to ascertain the effects of oils in contact with various metals.

The metals to be tested were first thoroughly cleaned with ether, and dried. The weights were then taken, and the metals placed in closed tubes filled with the oils, and kept for twelve months at a mean temperature of 27° C. during the summer and 10° to 13° C. during the winter.

The following results were obtained:—

Iron.—Least attacked by seal oil, and most affected by tallow oil.

Bronze.—Not attacked by colza oil. Very little affected by olive oil; but very considerable action produced by cotton-seed oil.

Lead.—Least acted upon by olive oil; greatest action noticed with whale oil. Lard and spermaceti oils have almost the same effect as whale oil.

Zinc.—Seemed but little attacked by mineral lubricating oils. The least action was with lard oil, and the greatest with spermaceti oil.

Copper.—Not attacked by mineral lubricating oils. Least affected by spermaceti oil, and most attacked by tallow oil.

The experiments show that mineral oils had the least effect upon the metals tested, and that the greatest action was produced by tallow oil.

The following table gives a *resumé* of the experiments:—

Oils.	Metals not attacked.	Metals least attacked.	Metals most attacked.
Mineral	Zinc and copper.	Bronze.	Lead.
Olive	—	Tin.	Copper.
Colza	Bronze and tin.	Iron.	Copper.
Tallow	—	Tin.	Copper.
Lard	—	Zinc.	Copper.
Cotton-seed ...	—	Lead.	Tin.
Spermaceti ...	—	Bronze.	Zinc.
Whale	Tin.	Bronze.	Lead.
Seal	—	Bronze.	Copper.

PROPOSED SCOTTISH ACADEMY OF SCIENCE.—Prof. Dunn, in his introductory address, read before the Royal Physical Society, urged that the principal scientific societies of Edinburgh should unite as a Scottish Academy of Science, each council to continue to manage the affairs of its own society and its own funds, but the united councils to have powers to elect distinguished men as Academicians.

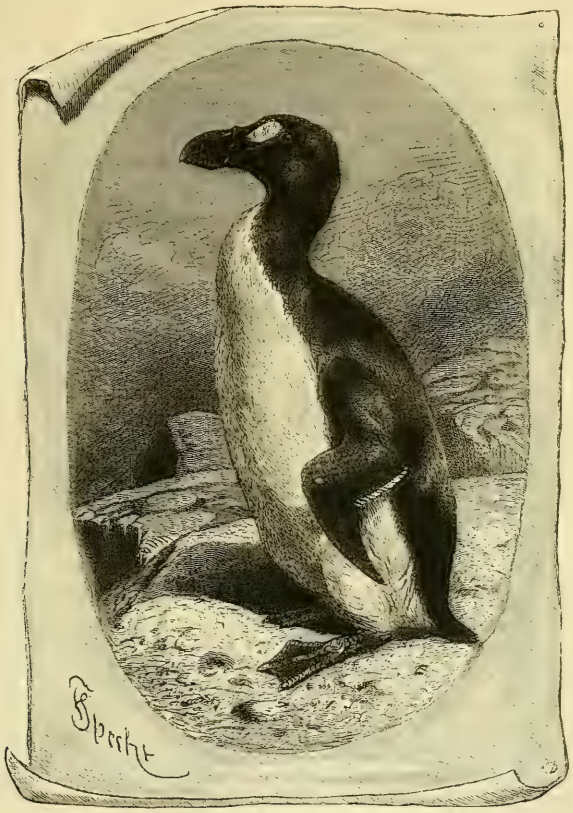
FIXING INDIAN INK DRAWINGS.—The lines in drawings made with Indian ink frequently "run" during the process of colouring; this may be prevented by mixing the ink with a two per cent. solution of red chromate of potash, instead of ordinary water. The potash salt, under the influence of light, forms an insoluble compound with the size with which the ink is prepared.

BLEACHING BY ELECTRICITY.—An electrical process of bleaching, of Russian origin, requires the mixture of 10 parts sodium chloride, 1 part carbonate of soda or potash, 1 part chlorate of soda or potash, 1 part glycerine, 87 parts water, whilst for silk bleaching simply solutions of sodium sulphate are required. By the electrical current oxygen is produced at the positive pole, while, by reacting on the chloride, and by a more complicated reaction, in which, according to the inventor, the carbonic acid also enters, ozone, oxygen, and peroxide of hydrogen are stated to be produced.

Natural History.

THE GREAT AUK.

GREAT interest has lately been aroused in ornithological circles by the sale of an egg of the Great Auk (*Alca impennis*) at a price which, to those uninitiated in the mysteries of bird life, must seem extravagant. It is not often, however, that collectors have a chance of acquiring an egg of this particular species of the genus *Alca*. It is seven years since the last was sold, and as the bird seems to be fast becoming, if it is not so already, as extinct as the *Epiornis*, the *Dinornis*, and the oft-quoted *Dodo*, opportunities of obtaining these eggs must of necessity be few and far between. The Great Auk has apparently not been seen alive by any observer on whom reliance can be placed for at least a quarter of a century, and prior to that, only at rare intervals in exclusively Polar regions, although it once was to be found in Iceland, Norway, Greenland, the Feroe Isles, and occasionally in various parts of Great Britain. Sir William Hooker mentions one found near Southwold in Suffolk, Mr. Bullock another taken on the estate of Sir William Clayton, Bart., near Marlow, Buckinghamshire, and Dr. Edward Moore has recorded one which was found dead on Lundy Isle, in the Bristol Channel, in 1829. One was once discovered on a sand-bank about 100 leagues from Newfoundland, but these birds seem to have been rare visitants in America. Although, according to ancient writers, Greenland was originally the home of this species, not a single specimen has been seen there for very many years. In the autumn of 1821, Dr. Fleming, in his cruise through the Hebrides, observed and described one which had been taken alive off St. Kilda, and a few years earlier another specimen was seen off Papa Westra, Orkney Islands, which for some time successfully eluded the efforts of a six-oared boat to overtake it, its short wings, useless though they were for flight, forming most powerful swimming organs. It was ultimately captured, and is now in the British Museum. Morris, in his "History of



THE GREAT AUK.

British Birds," mentions two killed at St. Kilda, one in the winter of 1822 (which may perchance be the one seen by Dr. Fleming in 1821) and another in 1829. Dr. Baikie and Mr. Robert Heddle write :—"A Great Auk was seen off Fair Island, Orkney, in the month of June, 1798, and a pair bred in Papa Westra, Orkney, for several years, where they were popularly known as the 'King and Queen of the Auks.' Shortly after Mr. Bullock's visit to Orkney in 1813, one of these birds was shot and sent to him, and since that time the Great Auk has apparently quite forsaken our islands." In 1834 one was found off the coast of Waterford, and the last survivor appears to have been taken in the Island of Eldey, in 1844, since when neither naturalists who have gone in quest of them, nor Arctic explorers have seen any signs of their existence. Possessing stunted wings, which practically incapacitated it from flight, and with short legs, which were but of little use for walking, the Great Auk's means of locomotion on land appear to have been restricted in the extreme, but it was an excellent swimmer and a most expert diver, living, according to Fabricius, entirely on fish, although other authors assert that sea plants also formed part of its diet. Like its lesser kinsman the penguin, it seems to have dispensed with the formality of a nest, and to have laid its egg—for it seldom laid more than one—on the bare rock, poising it, according to some writers, with marvellous exactitude on some jutting ledge, at what seemed an inaccessible height for a bird whose capacity for flight was so limited. Morris attempts to explain this apparent anomaly by suggesting that it raised itself to its breeding place by the aid of the waves which dash unceasingly against the desolate shores which these birds frequented, a supposition which seems more ingenious than probable. The egg is yellowish white, streaked and spotted, principally about the larger end, with black, and even many years ago was accounted "worth its weight in gold." Morris gives a minute description of the "Great Auk, Gair Fowl, or Northern Penguin," which we feel can not be improved upon ; we therefore give it in its entirety :—"Male : length, 2 feet 8 or 10 inches, Montagu says as much as 3 feet ; the bill, which is flattened at the sides and marked with several transverse grooves, is very strong and black in colour, the grooves white ; between it and the eye, and round the latter, is a large oval patch of white (as shown in our illustration) ; the base of the bill is covered with short velvet-like feathers. Iris, reddish-brown ; head, on the crown and sides, nape, chin, and throat, deep glossy black ; the two latter and the sides of the head are white in autumn and winter. Breast, white ; back, glossy black. Greater and lesser wing coverts, black ; primaries, black, the longest quill feather is only 4 inches in length ; secondaries, black, their tips white, forming a boundary to the wing ; tertiaries, black ; greater and lesser wing under coverts, white. Tail, black ; upper tail coverts, black ; under tail coverts, white. The legs, short and placed far back, are, at the toes and claws, blackish ; webs, blackish brown. Selby says that this species undergoes a double moult, and Dr. Fleming noticed that the change took place in a few days. In young birds it would appear that the bill becomes only gradually grooved, and the neck is mottled with black and white."

A Sporting Fish.—In the eleventh number of the *Edinburgh Philosophical Journal* an interesting account is given of the Jaculator fish of Java by a gentleman who had an opportunity of examining some specimens of it in the possession of a chief. The fish were placed in a small circular pond, from the centre of which projected a pole upwards of 2 ft. in height ; at the top of this pole were inserted several small pieces of wood, sharpened at the points, on each of which were transfixed some insects of the beetle tribe. When all had become quiet, after the beetles had been secured, the fish, which had retired during the operation, came out of their hiding-places, and began to circle round the pond. One of them at length rose to the surface of the water, and, after steadily fixing its eyes for some time upon an insect, discharged from its mouth a small quantity of water with such force and precision of aim as to drive the beetle off the twig into the water, where it was instantly swallowed. After this another fish came and performed a similar feat, and was followed by the rest till all the insects had been devoured. The writer observed that if a fish failed in bringing down its prey at the first shot it swam round the pond until it again came opposite the same object and fired again. In one instance, he remarked, one of the fish returned three times to the attack before it secured its prey ; but in general they seemed to be very expert shots, bringing down the game at the very first discharge. The Jaculator, in a state of nature, frequents the banks of rivers in search of food. When it spies a fly settling on the plants that grow in shallow water it swims on to the distance of from 5 ft. to 6 ft. off them, and then, with surprising dexterity, ejects from its tubular mouth a single drop of fluid, which rarely fails to strike the fly into the water, where it is immediately swallowed.

Ants.—Sir John Lubbock recently delivered a lecture on "Ants" in Essex Hall, Essex-street, Strand. The lecturer said that ants were of much interest to the human race, because they reproduced in so many respects the conditions of our own lives. When we considered their habits, their social organization, their large communities, their roadways, their possession of domestic servants, and sometimes, he was sorry to say, of slaves, it must be admitted that they had a very fair claim to rank in intelligence next to man. It was difficult to determine whether ants could be said to have any actual affection for one another. He related a number of experiments he had conducted to ascertain the truth in this respect. An ant which had injured her legs was fed and was carried by her companions. Another ant that had injured her antennæ in coming out of chrysalis, being found by an ant of another nest, was attacked, and was with difficulty rescued by the lecturer, but being afterwards found by an ant belonging to the same nest, this ant, after carefully examining her unfortunate companion, took her up in her mouth and carried her back to her nest. Nobody had ever yet seen a quarrel between two ants of the same nest. In one of his nests he had a number of workers which lived to the age of seven years. They gradually diminished in number, and at last only two remained. These two lived together for two years, and then died within a week of one another. There appeared to be no external cause for this, and he was disposed to think that the survivor felt the shock of her companion's death. Sir John said that he had now a queen-ant which had lived in one of his nests ever since 1874. She was even then full-grown, and must, therefore, now be nearly fourteen years old. She was, he believed, the oldest insect on

record, and though he regretted to say that she was not so active as formerly, and was now a little stiff in the joints, still, as far as he was able to observe, she was in perfect health, and he had every hope that he would continue to enjoy the pleasure of her society for some time. He had tried experiments to see if ants were capable of mutual recognition. He kept ants of the same nest apart for a year and a half, and on putting them together again he found that there was mutual recognition. He was afraid a great many men forgot their friends in a much less time. Desirous to know by what signal, password, or other means ants made their recognition, he reduced one set to insensibility. Chloroform not answering the purpose, he determined to make them drunk. He found that the only way to make an ant drunk was, not by enticing her to take poisonous spirit, but by putting her into the whisky. He then made the sober ants approach the drunken ants. At first the former did not seem to know how to deal with the latter. At last one of the sober ants took up one of the drunkards belonging to a different nest, looked at it, walked slowly to the end of the table, and dropped her into some water that was there. The stranger ants were all taken and thrown into the water, while the ants belonging to the same nest were carried back, where he had no doubt they soon recovered from the effects of the drink. This experiment proved that ants did not recognise one another by any password, but it also proved that their faculty of recognition was unerring. The lecturer proceeded to sketch the senses and moral qualities of ants, and gave numerous illustrations of their affection among themselves, their hostility towards ants belonging to other nests, and their powers of intercommunication.

Christmas Island.—Mr. J. J. Lister, who visited this island in H.M.S. *Egeria*, sends to *Nature* the following account of the flora and fauna of this island. It is entirely covered with trees, many of them reaching to 150 ft. to 170 ft. or more, and some of them have vertical buttresses at the base. They are often laden with great clumps of ferns, orchids, and parasitical trees, and are often festooned with long lianas. Along the shores grow thickets of screw-pines. Many of the trees bear edible fruits. There are swarms of rats (*Mus macleari*), and another species not determined, a shrew, a fruit-eating bat (*Pteropus natalis*), and a small insect-eating bat. A large pigeon (*Carpophaga whartoni*), and a small dove, which, from its colour, can scarcely be seen on the ground among fallen brown and green leaves. A thrush (*Turdus erythropleurus*) and a *Zosterops* are common. The author obtained, further, two hawks, an owl, a swift, a heron, a plover, and a sandpiper, three kinds of lizards, five kinds of land shells, four of butterflies, a few moths, eighteen species of beetles, besides spiders and centipedes. He is sending home fifty kinds of flowering plants and fifteen ferns. The highest point of the island is 1,200 feet above the sea-level, and it is coral-clad to the very top.

The Hessian Fly and its Parasites.—In an appendix to Miss Ormerod's pamphlet on the Hessian fly is given, perhaps, the most curious and interesting bit of information we have as yet had with regard to the Hessian fly. It will be recollected that in the summer Professor Fream made the welcome announcement that with the fly had come one of its most deadly parasites. Miss Ormerod has hatched out a number of these parasites, and these have been identified by Professor C. V. Riley and Dr. Lindeman. It thus appears that seven distinct parasites have been already identified, and curiously enough they are not only all Russian, but embrace all the parasites known to Dr. Lindeman. The names of these are as follow:—1, *Platygaster minutus*; 2, *Semiotellus nigripes*; 3, *Eupelmus karschii*; 4, *Merisus intermedius* (a very valuable species); 5, *Tetrastichus Rileyi*; 6, *Euryscapus saltator*—all species of Lind: and 7, *Dacnusa senilis*, Hald. It is very interesting to have this confirmation as to the suspected Russian origin of the pest, just as it is comforting to know that the Hessian fly has brought all his known enemies with him into the country.

Edible Birds' Nests.—Mr. J. R. Green, of the Cambridge Physiological Laboratory, has examined a number of these nests, and finds them to consist of gelatine or mucine. There was nothing to connect the matter with cellulose, and the algæ adherent are probably accidental.

Venation of the Wings of Insects.—Mr. Waterhouse of the British Museum, has communicated to the Entomological Society an important memoir on the "Homologies in the Venation of the Wings of Insects."

Death of Birds along Telegraph Wires.—Mr. R. D. Smillie, writing to the *Electrical Review*, speaks of numbers of birds found dead along telegraph wires. He doubts whether they have been killed by coming in violent contact with the wires, as in many cases no bones are broken and the plumage is unruffled. He has seen several small birds perch on and fall from a 19·12 bore cable carrying a 20-ampère current charging accumulators. He points out that the birds could not short-circuit the cables with their feet, as they are nine inches apart, and asks if the difference of potential in the short length of cable between the birds' feet, perhaps an inch, could cause their death?

WILL-O'-THE-WISP.—III.

(*Concluded from p.* 38)

Another hypothesis, advanced by certain very learned authors, such as Ray, Willoughby, Kirby, and Spence, ascribes the Wisp to luminous insects. Drs. Dereham and Phipson combat this view on the ground that such insects "rise far higher in the air than does the Wisp, and present the appearance of hundreds of little specks of light." This argument seems doubtfully valid. Luminous insects are, in all probability, more numerous than it is ordinarily suspected, and they vary considerably in their habits. The apparent size of the light may be considered a fatal obstacle, since no known English insect emits a light of the size of "two fists." But a mysterious light seen in the dark by a superstitious and terrified ploughboy will very naturally be described—and that without any intentional or conscious exaggeration—as much larger than it really was. The circumstances that the Wisp is chiefly seen in calm weather and during the summer season are in favour of this supposition. But we have some positive testimony to advance. The Rev. Dr. Sutton, of Norwich, informed Dr. Kirby that when he was curate of Ickleton, in Cambridgeshire, in 1780, a farmer of that place, of the name of Simpringham, brought him a mole-cricket (*Gryllotalpa vulgaris*), and told him that one of his people, seeing a Jack-o'-Lantern, struck at it and knocked it down, when

it proved to be the insect in question. Mr. Main ("Magazine of Natural History," N.S. I., p. 549) was told by a farmer that he had encountered and knocked down the luminous object, which he described as being exactly like a "Maggy-long-legs" (*Tipula oleracea*)—an insect especially abundant in boggy and marshy lands. I must here admit that neither of the above insects are known to be luminous.

Dr. Dereham, an opponent of the insect theory ("Phil. Trans.," 1729, p. 204), describes an *Ignis fatuus* which he had personally witnessed as flitting about a thistle—a very likely action for an insect, though very unlikely for a volume of inflammable gas. Mr. Sheppard informed Dr. Kirby that, when travelling one night from Stamford to Grantham on the top of a stage-coach, he observed "for more than ten minutes a very large *Ignis fatuus* in the low marshy grounds, which had the same movements as a *Tipula*, flying upwards and downwards, backwards and forwards, sometimes as settled and sometimes as if hovering in the air."

It is remarkable that in this case the wind is described as being very high, so that a gas or vapour would have been swept onward in a straight line, which was not the case. The insect theory, however, is not free from difficulties. Thus, the question at once arises, Why is this phenomenon so rare? It may also be asked whether the light given off by insects is sufficiently strong to be visible at such distances as the Wisp is said to have been.

The orthodox theory of the present day—that of spontaneously inflammable gases, hydrogen phosphide, marsh-gas, and possibly other hydro-carbons given off by decomposing animal or vegetable matter—is open to still more formidable objections. The presence of the spontaneously inflammable variety of hydrogen phosphide has never yet, I believe, been analytically demonstrated among the gaseous matter given off from marshes, pools, and graveyards.

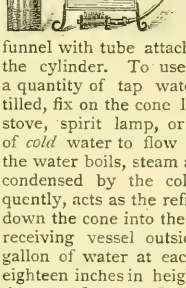
In Brande's "Dictionary of Science, Literature, and Art" (II., p. 191), the Wisp is ascribed to "the issue of marsh-gas from the earth. This gas being ignited either accidentally or intentionally, continues to burn with a flame sufficiently luminous to be well seen at night." The writer admits at the same time that no natural production of spontaneously inflammable gas has ever been observed. Now, supposing marsh-gas to be present, how is it to be "accidentally or intentionally" ignited? Either of these alternatives requires human intervention, exceedingly unlikely in the places where the Wisp has mostly been seen. Dr. Phipson seeks to get over the difficulty of ignition by assuming that the gas given off consists of marsh-gas, through which a small proportion of hydrogen phosphide is diffused. But an emission of inflammable gases from the earth or the water, however composed and however ignited, will not account for the facts in the majority of cases on record. In proof of this, let any one perform the simple experiment of stirring up the mud at the bottom of a dirty ditch or pond, and ignite the gas given off by means, say, of a piece of taper fixed at the end of a fishing-rod. The gas will burn immediately over the surface of the water, but the flame will not travel away for considerable distances—sometimes overleaping hedges, trees or buildings, or playing over thistles, and sometimes remaining stationary for a couple of minutes. It is further found that the Wisp is most common in calm, fine weather, when the barometer is high. But gases pent up in the mud in marshes, etc., will be most readily liberated when the barometer is low. Rainy and windy weather is not unfrequently foretokened by the rise of bubbles of gas from ponds and marshes. We may readily understand, indeed, that a light produced by inflammable gas might, if the supply was large and constant, hover over an extensive marsh or graveyard. But in such cases it would not be one and the same portion of luminous matter flitting up and down, but a succession of fresh bubbles, jets, or puffs of gas, becoming ignited in turn. This accords ill with the facts as reported by observers, who generally speak of a single, persisting light.

Another hypothesis refers the phenomenon to electricity. We often find that the less any person knows about electricity the more ready he is to account for any unexplained facts by its agency. Luminous manifestations of electric nature are certainly well known, such as the "castor and pollux," which appear at the extremities of the masts and yards of ships during stormy weather; similar lights have been noticed, especially in mountainous regions, attaching themselves to umbrellas, alpenstocks, etc. But these phenomena seem essentially distinct from the true *Ignis fatuus* which, as it has been said, is characteristic of fine weather, and moves about instead of attaching itself to pointed objects.

In all probability several distinct phenomena have been confounded under the name of *Ignis fatuus*, and careful observation is needed for their respective discrimination. Persons who live in or visit regions where the Wisp occurs might do good service by noting all the circumstances of the case at the earliest possible opportunity. The character of the soil, the barometric pressure, the temperature, the wind, and, in short, the entire aspect of the weather, should be recorded, and an attempt should be made to take the spectrum of the light, which would be a capital piece of evidence.

PORTABLE STILL.

THE annexed woodcut shows the sectional elevation of a little still, designed for the use of photographers, chemists, perfume makers, and others requiring apparatus that shall be at the same time compact, reliable, and economical. The still in question is entirely free from the complicated and bulky parts of the ordinary "worm" apparatus. It consists of a cylinder having as a lid an inverted cone, the apex of which, when fixed in position, rests exactly over a funnel with tube attached passing through the side of the cylinder. To use the still, pour into the cylinder a quantity of tap water and the substance to be distilled, fix on the cone lid, place the whole over a gas stove, spirit lamp, or fire, and permit a gentle stream of *cold* water to flow in and out of the cone. When the water boils, steam arises, and settling on the lid, is condensed by the cold water outside (which, consequently, acts as the refrigerator), the purified water runs down the cone into the funnel, whence it passes into the receiving vessel outside. A still, made to distil one gallon of water at each operation, measures less than eighteen inches in height by eight inches diameter, and the manufacturer, C. C. Vevers, Horsforth, Leeds, supplies such a machine at 8s. 6d. each.



REVIEWS.

Colour: An Elementary Manual for Students. By A. H. Church, M.A., F.C.S. New and Enlarged Edition, with Six Coloured Plates. (Cassell and Co., 1887.)

It is to be regretted that when revising and enlarging this valuable little work, the main subject has not been still further amplified, for we find the first fifty pages out of a total of less than two hundred, are occupied by a general account of the theory of light and production of colour, and in the latter chapters the author enlarges on the æsthetics of architecture, ceramics, and jewellery. The list of contents is followed by a page of bibliographical notes, which are too rarely to be found in an English text-book, and which remind us that only two other modern English works are devoted to the subject of chromatics or the science of colour. We observe that no table of wave-lengths is given, a rather serious omission, when, owing to the "vagueness which seems to be inherent in the nomenclature of colour," a simple hue can only be accurately specified by reference to its position on the spectrum. The want is apparent, for example, when the three primary sensations of Maxwell and Helmholts are described on p. 68, "Maxwell's green is to be found at one quarter the distance from E, between E and F, and resembles emerald green in hue." We are not informed whether the prismatic or the normal spectrum is referred to, and the position would be much more accurately described by stating (in addition) that the wave-length is 501 millioneths of a millimetre. Although frequent mention is made of Maxwell's rotating discs for the combination and study of colours, the method is not recommended so strongly as it deserves; offering, as it does, the greatest facility for quantitative analysis, a large area of perfectly uniform colour for examination, and the advantage of being easily and cheaply constructed by one who cares to experiment for himself. We doubt if "it is so easy for any one studying the subject of colour to examine for himself the actual appearances presented by the spectrum," for not only is the apparatus somewhat expensive; but the management of a darkened room, and an efficient substitute for sunlight on dull days, are matters of considerable trouble to any one who has not access to a properly equipped laboratory. The chapters on contrast, contact, and separation, mutual influence, harmonies and balance are full of matter which must be of the highest importance to manufacturers of textile fabrics, as well as to those engaged in decorative and pictorial art The coloured plates aim only at the simplest effects, and are offered as rough approximations to the true hues; and thus succeed in forming a valuable feature instead of a misleading eyesore. A number of useful tables of classified colours are given, and some attention is directed to the "broken hues" such as russet, olive, sage, slate, "of which ornamental art constantly makes such admirable use." Most of these are defined and the components and complementaries specified, but "puce" and "buff" are only alluded to, and not appear in any of the lists. The chemical propensities of the author come out in calling the familiar "hypo" of the photographer, "sodium thiosulphate"; and in attempting to describe a certain kind of pink, it is likened to the rose acacia, the almond blossom, the flowers of the double peach, and finally, "it is, perhaps, more closely represented by the flame of burning cyanogen."

A few slips occur, is in Fig. 3, where a beam of light after passing two prisms in Newton's second experiment, is shown as parallel, instead of diverging; and a triangle is spoken of on p. 59, as being a figure of one dimension. Green is printed for yellow on Fig. 31. The author acknowledges his indebtedness to Ogden Rood, the author of "Modern Chromatics," and cites a curious observation as being due to him, relating to the admixture of black and white. "It is generally allowed that even the purest black pigments, as free as possible from any tinge of colour, yield, when mixed with white pigments, a *bluish* grey. This has been usually attributed to the fineness of the particles producing a blue colour by the same notion on the light as an opalescent medium. But it has been shown that when white and black are mingled optically on a rotating disc, the grey they yield is matched in hue (not in brightness) by a white disc into which 17 per cent. of blue, in the form of a strong wash of indigo, has been introduced. The real cause of the blue tinge produced in these cases seems to be traceable to the fact that, with a low illumination, the nerve-fibrils of the retina which correspond to the sensation of the blue are called into action more energetically than those which give the sensations of red and green, and so the white we see on looking at a neutral grey is tinctured with blue." Mr. Church's manual cannot fail to be a useful supplement to the artistic instinct of the designer, who plays so important a part in many manufacturing industries contributing to the beauty and comfort of our homes, and will explain in a popular manner the leading facts of a very attractive science to those who may take it up for its own interest.

Lectures on Bacteria, by A. De Bary. Translated by H. E. F. Garnsey, M.A., and J. B. Balfour, M.A., M.D., F.R.S. Second edition. Oxford: Clarendon Press.

This is the book our readers want. The translators say there is no other book in English which gives a general view of the subject, and sets forth the known facts in the life of bacteria in their connection with those with which we are acquainted in other branches of natural history; and the author says he has had to make himself intelligible to all who were not strangers to the elements of a scientific training. The translators are right, and the author is successful. A difficult but deeply interesting subject is here brought before us clearly and simply, as clearly and simply as is possible consistently with scientific accuracy and completeness. We are tempted to quote largely, but our limited space forbids; we cannot refrain, however, from speaking of the ingenious way in which Professor De Bary has refuted Wigand's theory of equivocal generation. Wigand states that motile bacteria are found in the healthy living cells of the leaf of a South American water-plant, *Trianea Bogotensis*. Professor De Bary makes the following remarks on this:—"If living tissue from the fresh healthy leaf is placed under the microscope, we shall really see in many cells the prettiest representations of the appearance of bacteria, small slender rods, isolated or attached together in short rows, and actively following the movements of the protoplasm and other cell contents. An excellent representation, as I said, or model. But a drop of dilute muriatic acid destroys the illusion." The pseudo-bacteria are simply small crystals of calcium oxalate, and with them dissolves the elaborate superstructure built upon their misleading forms.

My Hundred Swiss Flowers, with a Short Account of Swiss Ferns. By Mary A. Pratten. London: W. H. Allen and Co.

This volume is certain to charm our lady-readers, as, indeed, all lovers of nature. The author describes and figures a hundred of the most characteristic and beautiful flowers to be met with by the tourist in Switzerland. Of four species well deserving the honour, we find coloured plates. Foremost among these, ranks *Rhododendron ferrugineum* the western representative of that noble family which has its chief seat in the Himalaya. Then comes the "Edelweiss," which, by the way, occurs also in the mountains of New Zealand, though, as far as we are aware, not in any intermediate locality. The plant seems to have had greatness thrust upon it; its whiteness is of a decidedly dirty cast, and in its form there is no remarkable grace. Beyond all comparison, more lovely are the Gentians, of which one species, *Gentiana bavarica*, is here figured in its true colours. *Androsace Heerii*, with its glowing masses of red flowers, completes this select list.

A remarkable fact here noted is that our common fox-glove does not occur in Switzerland, except where it has escaped from gardens. It is also remarked: "Nor have the Swiss any of our cross-leaved or common heath. They have *Erica carnea* and plenty of ling, but none of the heather which gives such a beautiful tinge of purple to the Scotch mountains, and the lower hills in many parts of England. We suspect here some confusion among the familiar names of the heaths. We have always heard the name "ling" (*Calluna vulgaris*) applied to the heather, the commonest heath both in Scotland and England. *Erica tetralix* and *E. cinerea*, which are much more beautiful, are less plentiful.

On perusing this book we are struck with a very singular fact: we see that the flora of elevated regions even closely bordering on perpetual snow is remarkable for its brightness and purity of colour. On the other hand, the animals—especially the reptiles and insects—haunting the higher mountains, are for the most part of dull and sombre hues. This contrast is, in our opinion, fatal to two plausible theories of the origin of colour in animals. One of these ascribes their brilliant hues to the action of intense light and pure air. The other, that of Mr. Grant Allen, asserts that animals are beautiful in colour in proportion as, in feeding, they come more in contact with flowers and fruits of rich and varied hues.

Another reflection is of a sadly practical nature. Mrs. Pratten laments with good cause that, like certain localities nearer home, they also are being gradually denuded of their choicest plants. Dealers and "exchange societies"—the latter a nuisance of modern origin—work by wholesale where the travelling botanist is content with a couple of specimens. We wish all success to the Association for the Protection of Swiss Plants, which has its head-quarters at 8, Rue du Mont-Blanc, Geneva.

This book deserves our most cordial recommendation.

Unfinished Worlds. A Study in Astronomy. By S. H. Parkes, F.R.A.S., F.L.S. London: Hodder and Stoughton.

"Unfinished Worlds" is a good title for an elementary account of nebulæ, stars, planets, and satellites. The author is himself an observer, and writes with more enthusiasm than a mere compiler; but the good descriptions and arrangement of the strictly astronomical portion, which contains a considerable amount of information in a small compass, are marred by such expressions as "that inconceivably grand and terrific momentum, termed parabolic or hyperbolic force," and "every star is a great magnet," meaning merely a centre of attraction. The worst disfigurement of what would otherwise be a useful book to place in the hands of those for whom it is written, viz., "general readers, especially those in early life," is the execution of the illustrations. The process by which they are produced seems capable of doing justice to more carefully finished and better-drawn originals. Towards the end of the book, astronomy is dropped, and biology and evolution, on which the author is less conversant, are the theme. He does not actually deny the theory of evolution, but seems to regard it with apprehension, and is suspicious of Darwin and all his works. The twenty million years which "Sir W. Thompson" gives as the greatest age of the sun is hailed with some satisfaction as "so much the worse for evolution." If it had been rather nearer 4004 years, he would doubtless have been better pleased. Such opinions do not carry much weight when they are those of a writer who does not even know how to spell the name of one of the leading men of science of our time.

Proceedings of the Bristol Naturalists' Society. New Series. Vol. V., Part II., 1886-7.

The volume before us shows that the Bristol Naturalists' Society is laudably active. We find here papers by Professor C. Lloyd Morgan, on the "Bristol Building Stones," on the "Origin of Mountain Ranges," on the "Severn Tunnel Section," and on the "Senses and Sense Organs of Insects," a fairly wide range of subjects. Like ourselves, the author considers it very probable that the sense organisation of insects is very different from that of man. He suggests that, for instance, they may have a special sense for heat-rays, which may thus convey to them impressions more definite than the mere sensation of a higher or a lower temperature. He reminds us that, as it appears from the researches of Sir John Lubbock, ants are sensitive to the ultra-violet rays, which to our eyes are perfect darkness. Our organisation has no means of responding to undulations of the ether below 30 million millions per second, between that figure and about 400 million millions, and again above 800 million millions. Here, surely, there is at least the possibility of senses other than those which we possess.

Mr. W. P. Mendham communicates a paper on the "Deposition of Smoke and Dust by means of Electricity."

The author discusses the various means by which dust suspended in the atmosphere can either be condensed or prevented from settling. It was discovered by Lord Rayleigh that a stream of air, free from dust, descends from a cold body. Hot bodies, on the contrary, are surrounded by a film of air absolutely free from dust, and produces an ascending stream of dustless air.

Some thirty years ago M. Guitard observed the effect produced by an electrical discharge taking place in a volume of smoke confined within a bell-jar. He describes the rapid condensation of the smoke as perfectly magical. The principle, improved in its details, has been applied to effect the condensation of the fumes from lead-works, and has met with some success.

The author suggests that the same method might prove available for condensing the fine dust in flour mills, which is now well known as a source of danger, being under certain conditions inflammable and explosive. The dust of flax-mills, which is a nuisance not merely to persons employed in the building, but to all who pass

along an adj cent street, m'ght possibly be thus dealt with, as also the coal-dust in very dry mines, which powerfully reinforces the explosive force of "fire-damp."

Mr. S. W. Tyack writes on the "Physical Formation of the Earth." He tells us that the sphericity of the earth is now never called in question. He is here unfortunately mistaken. There exists a small clique who pertinaciously maintain the flatness of our world, and who must find funds to carry on their propaganda, since they ever and anon send tracts and leaflets to the journals, both scientific and general, with the effect of replenishing the editorial wastepaper-basket.

At one of the meetings of the Society, Mr. F. F. Tuckett, of Frenchay, sent in "a *white* variety of the common blackberry, a single plant of which had been found growing in an old quarry in the neighbourhood."

A letter was read from Professor Raphael Meldola, who is now acting as secretary to an association for "Promoting the Investigation of various Phenomena on which wide-spread Observations are much needed." Among the subjects especially mentioned are the erratic boulders of Great Britain and Ireland; the circulation of underground water; the migration of birds and the disappearance of native plants from their original habitats. The association in question deserves general encouragement.

There is further much interesting matter in this volume, to which, from lack of space, we are unable to draw attention.

Inorganic Forms. By Rev. H. H. Higgins, M.A. Liverpool: Literary and Philosophical Society.

This pamphlet is the reprint of a paper read by the author in November last before the Literary and Philosophical Society of Liverpool. In it he sets aside the common error that crystals are to be regarded as links connecting the inorganic to the organic world. This is a point of some importance, since certain writers have put forward the distinctions between crystals and organisms as an argument against Evolution. It is to be remembered that nearly sixty years ago Lorenz Oken maintained that the crystal, instead of forming a bridge or a stepping-stone between the fragment of lifeless matter and the plant or animal, was in reality a departure in a different direction, and that consequently contrasts between the two are what we should expect, and what the true conception of Evolution demands.

Mr. Higgins finds an approximation to living beings "in these inorganic forms, and in the frequent repetition of parts with a regularity almost rhythmical, and a kind of prefigurement of what matter was quite capable of doing." As instances, he mentions the ribbon jasper from the Ural Mountains, the bloodstone, the variety of granite known as Napoleonite, the arborescent forms in moss-agate and in Mocha-stone, and, perhaps most of all, in the so-called turtle-stones and beetle-stones, which are by no means fossils. We should recommend the careful examination of such minerals to our friends when visiting museums.

New Professorship at the Sorbonne.—The Paris Municipal Council have recently voted 12,000f. per annum for a Professorship of Evolution, or biological philosophy, at the Sorbonne, on condition of having a veto on the appointment of the professor. It was urged that the doctrine of evolution was taught at Jena, Heidelberg, Würzburg, Vienna, Geneva, and Pavia, but was ignored in France, though the Frenchman Lamarck (?) was its author.

THE SUMACH.

THE sumach, the *Rhus Coriaria* of botanists, is one of the chief products of Sicily. It appears in the market of England and America, packed in bags of from 50 to 60 kilos, in the form of a more or less coarse powder, produced by the grinding of the twigs and leaves when dried. The dried twigs and leaves are exported to France before being ground. This powder serves both as a dye and as a mordant to fix other dyes and for purposes of tanning. Good sumach contains from 20 to 30 per cent. of the dyeing or tanning principle. The shrub is said to have been originally transplanted from Asia, and flourishes most in high and dry soils, and requires little attention after first planting. The plants, when once set out, will last for a century or two. For the first three years the leaves have little value, but after that time they acquire the due proportion of their peculiar qualities. The plant is a low perennial shrub with long, slender leaves. The harvest of the plant is made by cutting off the leaves every year, after which the plant throws out shoots. Sicilian sumach, especially that about Palermo, enjoys a high reputation, much more than the sumach of Spain and Portugal. The soil of Dalmatia is also peculiarly fitted for this plant, and its cultivation is fostered by the Austrian Government. The largest and most luxuriant plants do not produce the greatest amount of tannin, and even in Sicily there is great difference in the quality of the powder produced from the plant. The sumach powder produced in Sicily is of two sorts. The best is of a rich green colour and carefully sifted; it is soft to the touch, of a rather pleasant smell, and of a strong astringent taste. The second has these qualities in inferior degree, while its colour degenerates and takes a reddish hue. The sumach grown in continental Italy is much inferior to the Sicilian, and has a yellowish colour tending both to green and red. None of the inferior sorts are prepared with such care as the best Sicilian, and they are known by the prevalence of unground fibres and minute chips, indicative of less pains taken in sifting. Various adulterations are practised in preparing sumach for the market. The most obvious—that of mixing it with mineral dust—can be discovered by steeping the suspected powder in water, when the mineral portions will fall to the bottom. Where vegetable substances, however, are used chemical analysis must be employed.

The Electric Light in Railway Trains.—According to *Industries*, the example set by the Boston and Albany Railroad in lighting their trains by electricity is now being followed by some Canadian railways. The first train in the Dominion lighted by Julien storage batteries and incandescent lamps is that running between Montreal and Ottawa. On this train a Pullman drawing-room car, one first-class, and one second-class car are fitted with incandescent lamps, the total number being fifty-one. The battery is carried in the first-class car, and the current is supplied to the Pullman in front and to the second-class car behind by flexible connections, the contact plugs being protected by india-rubber covers which automatically close when the car is uncoupled, and so prevent moisture or dirt getting to the contacts. Charging stations will be established at Halifax, Moncton, St. John, Point Levi, and Montreal.

The Beluchistan Petroleum Wells.—The borings at Khatan, in Beluchistan, are commencing to give indications of a large and constant supply of petroleum. If these expectations be realised, the Quetta Railway will find a local supply of cheap fuel, which it is sorely in need of.

ABSTRACTS of PAPERS, LECTURES, etc.

GEOLOGICAL SOCIETY.

At the meeting held on December 21st, 1887, Prof. J. W. Judd, F.R.S., President, in the chair, the following communications were read :—

1. "On the Correlation of some of the Eocene Strata in the Tertiary Basins of England, Belgium, and the North of France." By Prof. Joseph Prestwich, M.A., F.R.S., F.G.S.

Although the relations of the several series have been for the most part established, there are still differences of opinion as to the exact relation of the Sable de Bracheux and of the Soissonnais to the English Series; of the Oldhaven Beds to the Woolwich Series; and of the London Clay and Lower and Upper Bagshots to equivalent strata in the Paris Basin. The author referred to the usual classification in the Eocene Series, and proceeded to deal with each group in ascending order.

The *Calcaire de Mons* is not represented in England, but may be in France by the Strontianiferous marls of Meudon. It contains a rich molluscan fauna, including 300 species of Gasteropods, many of which are peculiar, but all the genera are Tertiary forms. The *Heersian* are beds of local occurrence, and the author sees no good reason for separating them from the *Lower Landenian* or *Thanet Sands* He gave reasons for excluding the *Sands of Bracheux* from this group. Out of 28 Pegwell Bay species, 10 are common to the Lower Landenian, and 5 to the Bracheux Sands, which present a marked analogy with the Woolwich Series. These Sands of Bracheux are replaced in the neighbourhood of Paris by red and mottled clays. Out of 45 species at Beauvais only 6 are common to the Thanet sands and 10 to the Woolwich Series. Out of 75 species in the *Woolwich and Reading Beds*, 19 occur in the Bracheux Beds, it we add to these latter the Sands of Chalons-sur-Vesles.

Respecting the *Basement Bed* of the London Clay (*Oldhaven Beds* in part), the author would exclude the Sundridge and Charlton fossils, which should be placed on a level with the Upper Marine Beds of Woolwich. He allowed that the former were deposited on an eroded surface, but this involves no real unconformity, whilst the palæontological evidence is in favour of this view since out of 57 species in the Sundridge and associated beds, only 16 are common to the London Clay. He therefore objected to the quadruple division. Either the Oldhaven should go with the Woolwich or with the Basement Bed. He admitted that the term "Basement Bed" is objectionable, and preferred Mr. Whitaker's term for the series, as he would limit it.

The *Lower Bagshot Sands*.—The author would call "London Sands," whose Belgian equivalent is the Upper Ypresian, and the French the Sands of Cuise-la-Motte, forming the uppermost series of the Lower Eocene. A group of fossils has been discovered in the Upper Ypresian sands of Belgium, which leaves no doubt of their being of Lower Eocene age, and consequently the Lower Bagshots must be placed upon the same horizon. There is no separating line of erosion between the London Clay and the Lower Bagshots, the upper part of the former is sandy, and the lower part of the latter frequently argillaceous. Similarly no definite line can be drawn between the Upper and Lower Ypresian; but in both countries this series is separated from overlying beds by a well-marked line of erosion. So also in France the base of the *Calcaire Grossier* (Bracklesham Beds) is a pebbly green-sand resting on an eroded surface of the Sands of the Cuise-de-la-Motte. In Belgium, in Whitecliff Bay, and in the Bagshot district the Upper Eocene rests upon an eroded surface of the Lower Eocene.

2. "On the Cambrian and Associated Rocks in Northwest Carnarvonshire" By Prof. J. F. Blake, M.A., F.G.S.

After referring to the published views of Professor Sedgwick, Sir A. C. Ramsay, and the Geological Survey, Profs. Hughes and Bonney and Dr. Hicks, concerning the area in question and especially as to the presence or absence of Pre-Cambrian rocks, the author gave an account of his own explorations and their results, the principal of which were the following :—

In the Bangor and Carnarvon area three distinct conglomerates had been confounded. The only one that showed distinct unconformity on the underlying rock was of Arenig (Ordovician) age. The rocks of the southern and central portion of the area were essentially of igneous origin and might be distinguished into two groups, the southern probably intrusive, the northern certainly eruptive. There is no evidence to show what interval of time elapsed between the production of these two groups nor which of them is the earlier, although the author regards it as more probable that the southern mass is of the earlier date and overlain by the northern portion. The Bangor beds are derived from the denudation of the volcanic series, and of rocks which may have been associated with it, and they contain a series of conformable conglomerates, of which the great conglomerates near Bangor are members. They are the continuation of the Cambrian rocks seen to the east, and have not undergone any serious alteration. The porphyries of Llyn Padarn and Moel Tryfaen are contemporaneous lava-flows in the midst of the Cambrian Series, the overlying conglomerates being derived from them and from the sedimentary Cambrian rocks to the west; and hence there is no certain proof of there being any Pre-Cambrian rocks in the whole district, though it is probable that the rock near Carnarvon belongs to an epoch distinct from and anterior to the Cambrian.

EDINBURGH PHILOSOPHICAL INSTITUTION.

The Hon. Ralph Abercrombie recently delivered a lecture on "Cloudland in Folklore and in Science." The lecture was illustrated by limelight photographic views of the various species of clouds to which reference was made. His purpose, the lecturer stated, was to examine the ideas which the forms of clouds had suggested to different nations, and to make some reflections on the attitude of mind induced by the ancient or figurative poetic way of looking at things as compared with the modern scientific spirit. Cloud forms were the same all over the world, and there were only six or seven essentially different types of cloud-structures. There were many interesting survivals of the old way of regarding clouds; the well-known hairy or fibrous structure, for example, which formerly suggested to the Greeks hairy monsters and chimeras, were now known as goats' hair or mares' tails. The fleecy structure formerly held as resembling flocks of heavenly sheep was still called by such names as "wool-pack" and "mackerel sky," while the rocky, cumulus cloud, which once suggested the idea of many-headed monsters, was now in certain cases called "thunder-heads," "wind dogs," or "boars' heads." The peculiar hairy structure in front of heavy masses of

cumulus in a thunderstorm gave the idea in the Norwegian Eddas that Thor's chariot was drawn by goats; while the drooping form of the same cloud, the festooned cumulus, looked to the early Aryans as the udders of the cows of Indra. The peculiar kind of cloud through which the sun streams in apparently diverging rays of light was also described, and in connection with it the lecturer read the Pacific legend of Maui, who is related to have bound the rising sun with slip-knotted ropes of cocoa-nut fibre to prevent his too early setting, the rays, as seen in the morning and evening, being described as "the ropes of Maui." The appearance was best known in this country as "the sun drawing water." The imagery which the people saw in the clouds depended on their attitude of mind or on any prevailing excitement. Examples of this were given in the figure of an inverted crescent with a sword through it, seen by the Turks at Vienna, the vision of a kilted Highlander at Windsor on the eve of Culloden, and the appearance of an Irish harp at North Berwick in September last. So long as cloudland was peopled by terrible beings, the tendency of that attitude of mind was to make men afraid. The productions of the poets intensified this feeling. Modern meteorology, on the contrary, conjured up the picture of a sea of vapour-laden air eddying in a very limited number of ways, and developing an equally limited number of cloud-structures. Man lived at the bottom of that atmospheric ocean, and he was now learning to utilise the indications of clouds for his own benefit. The moral effect of weighing and measuring, as, for example, the waves of the sea, was entirely destructive of vague terrors. Modern science was not merely the collection of facts, but the means of building up that attitude of mind which raised man to a higher level, instead of prostrating him before the creatures of his own imagination.

BIRMINGHAM AND MIDLAND INSTITUTE.

A LECTURE was given by Professor Darwin on "The Ring of Saturn." The object of his lecture was to give an account of the investigations by which it has been discovered how that ring is built up. His reason for selecting this subject for his discourse was the desire of rescuing from unmerited neglect one of the discoveries of a French astronomer and mathematician, M. Edouard Roche, who died in 1883. It might easily be imagined, he said, that so extraordinary an appendage as a flat ring has excited amongst astronomers abundant speculations as to its constitution, its history, and its future fate. As is usually the case, what we now confidently believe to be the truth has only been reached by degrees. Herschel thought that the ring was solid because it shone so brilliantly, and Laplace investigated the shape which such a solid ring must have, if it is not to break in pieces, and if it is to continue to revolve about the planet. Fifty years after Roche, in treating a problem of abstract celestial mechanics, arrived indirectly at a most interesting conclusion concerning Saturn's ring. The lecturer then proceeded to give an account of Roche's paper. He first explained that the attraction of the earth on the moon is such that the moon is not perfectly spherical, but that her body protrudes towards the earth; so that she is slightly egg-shaped, with the long axis of the egg pointed towards the earth. If the moon revolved round the earth nearer than she actually does the elongation of the egg would be more pronounced, and if she were very near to the earth her body would be so much elongated that she could not continue to cohere together, but would break up into globules. Roche then succeeded in discovering the utmost limit of the elongation which the moon or any satellite can endure, and how far from the planet the satellite is when thus elongated. An egg-shaped model was exhibited to show this extreme limit of elongation. Roche proved also that the satellite when in this condition is at a distance of two and eleven twenty-fifths of the planet's radius from the planet. This distance the lecturer called Roche's limit. The meaning of this is that if a lump of matter were set to circulate round a planet at less than two and eleven twenty-fifths of a planet's radius from the planet, then the forces to which it would be subjected are such that it would be rent in pieces. Roche's limit for Saturn is found to coincide almost exactly with the outside edge of the ring, and hence the conclusion is arrived at that the ring consists of rocks, dust, and fragments, circulating independently round Saturn. This, then, is the constitution of Saturn's ring, and since the date of Roche's paper was 1848, in justice to him the discovery in question ought to be dated from that year. Roche's work, however, passed unnoticed, even up to the present time, and it was not until nine years later that the same discovery, announced by Maxwell, of Cambridge, commanded the general attention of men of science. Maxwell's essay formed a masterly discussion of the mechanics of Saturn's ring, and he was recognised as the chief authority on the subject. In conversation he used to describe the ring as a "shower of brickbats," and he showed that the inevitable collisions between "the brickbats" would, in some long but indeterminate period of time, bring about the destruction of the system of rings.

ROYAL SCOTTISH SOCIETY OF ARTS.

AT a meeting held in Edinburgh on December 12th, Mr. W. D. Cay, C.E., read a paper on the construction of marine works with concrete bags, and the plant used for their deposit. He noticed some previous cases of the use of sacking in the laying of concrete foundations. The use of sacking bags, however, had been first introduced by himself at the building of the Aberdeen breakwater. There the concrete bags had been dropped into position by means of a hopper barge. The barge was fitted with bottom doors. When in use her hold was lined with jute sacking, the concrete was then filled in and the sacking sewed up. The barge was towed into position, the bottom doors were opened, and the concrete bags dropped down into position, fitting accurately over each other. The barge used at Aberdeen carried fifty tons of concrete, and barges carrying a hundred tons had since been used. The breakwater at Aberdeen had now stood twelve years, and it had been reported this year that it had required but fifty pounds to keep it in repair since that date. Mr. Cay also described the dropping into the water of concrete bags from boxes or skips carried by cranes, in which the arrangement of bottom doors was the same.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

A MEETING of this Institute was held on December 10th, Sir Lowthian Bell (President) being in the chair.

The Secretary read the report of the committee appointed to inquire into the observations on earth tremors, with a view to determine their connection, if any, with the issue of gas in mines. Experiments with a seismo-

graph have already been made at Marsden, and seven months' results are given in the paper. An interesting feature in the records is the irregular and perturbed movements which lasted from February 7th to March 12th, 1887, and which appear to be connected with disturbances originating at places far distant from the observatory at Marsden; and it is considered probable that the shocks experienced at St. Louis, in the United States, on February 7th, were more violent results of the motions recorded here on the same day. These motions continued until February 23rd, the date of the disturbances at Nice and adjacent district, and ceased on March 12th, when the series of Italian disturbances were over. The shocks recorded on March 14th seem to have been reverberations of those experienced in Bohemia and Burmah. These experiments have been made with somewhat rough apparatus, but will shortly be extended with the aid of a more perfect form of seismograph, made from the designs of Professor Ewing, of the University College, Dundee, and the continued observations will be accompanied by the measurements of the percentage of gas found in the return air of the mine, which will be made by some of the best apparatus for such purposes. The measurements of the proportions of gas have not been made up to the present time, but it may be mentioned as at least a curious coincidence that the disturbances of December 6th and 8th were closely followed by increased issues of gas at several of the collieries in this district.

Professor Lebour said the British Association, at its meeting held at Manchester, after considering the work that had been done by the Earth Tremors Committee of this Institute, had thought it desirable that the observations should be extended over a greater part of the country; and the British Association appointed an influential committee to consider the advisability and possibility of establishing a network of seismological observations over England. The British Association committee were to consider whether the work as done by this Institute was to be imitated or not. Sunderland was the locality which first called the Institute's attention to these earth tremors.

Mr. James M'Kinless described "A Gauzeless Safety Lamp." This is a species of lamp like the Mueseler, in which the flame is surrounded with a glass cylinder, but, unlike the Mueseler, it has no gauze. The air is admitted above the flame by means of very small holes drilled through a brass ring about $\frac{1}{8}$ of an inch thick, each hole forming a kind of tube of considerable length as compared with its diameter; thus the heat-absorbing surface is very great. A similar mode is employed to allow the heated air to escape. An internal cone or chimney is so arranged as to protect the glass at the top from the action of the flame should the lamp be tilted.

Mr. Emerson Bainbridge also described "A Miner's Safety Lamp designed to meet the Requirements of the Mines Regulation Act which came into force on January 1st." The lamp is composed of only four movable parts, which are simple and easily put together. By a simple shut-off arrangement the inlet of air which supports combustion can at once be closed if the presence of gas is discovered.

BOURNEMOUTH SOCIETY OF NATURAL SCIENCE.

Mr. C. Carus-Wilson, F.G.S., delivered a lecture on "Grains of Sand," in which he pointed out that sand is a product of the disintegration and subsequent attrition of granitic or siliceous rocks. Granite is composed of three minerals, quartz, mica, and felspar. Of these felspar is the first to decompose, containing in its composition silicate of alumina, which absorbs water, and becomes a hydrated silicate of alumina. It then crystallizes and forms the basis of all clays. The felspar being thus decomposed, granite becomes a soft plastic rock, so soft, indeed, that it can be cut with a knife as clay. In this way the constituents of granite are washed away by the action of water, the felspar to form clay, the mica micaceous slates, and the quartz granules the sands and sandstones. Quartz is one of the hardest minerals; its degree of hardness is seven in the scale, thus being only three behind the diamond, the hardest substance known. It is composed of oxygen and silicon, and crystallizes in the hexagonal system, commonly known as the six-sided prism. The lecturer showed that grains of sand might be angular, sub-angular, rounded, spindle-shaped, or cylindrical and occasionally hexagonal prisms. The shape was seen to depend largely on the forces that had been at work on them. Thus, blown sand was usually composed of rounded grains, owing to the amount of friction they had undergone. The colour of sand varies from pure white to deep black, depending on the kind and amount of mineral matter with which the grains were associated or surrounded. Sands were shewn to be generally coloured externally, as those coloured throughout, such as amethyst, cairngorm, or jasper were extremely rare. Attention was drawn to the various agencies of rivers and streams, by which sand is transported to lakes and seas, there to form deposits which, in their turn, will probably become rocks, and may in future ages be disintegrated again. To show the vastness of these agencies it was mentioned that the Mississipi annually carries down to the sea seven hundred and fifty million cubic feet of sand, gravel, and vegetable matter, a quantity sufficient to form a solid mass nearly a mile square, and two hundred and seventy feet high. When the sand has been deposited in lakes and seas it has only to become compact and coherent to form sandstones. As a rule some mineral matter, such as iron silica, or lime was deposited round the grains, so forming a cement which subsequently binds them together. The most durable sandstones are those in which the grains are united together by a siliceous cement, the most notable examples of this class being the Agglestone Rock at Studland, and the masses at Stonehenge, which are known as sarsees. Nearly all sandstone is porous and admits the free percolation of water, the carbonic acid it contains dissolving the mineral cements. Attention was called to the commercial and domestic uses of sand in building and glass manufacture. The lecturer also pointed out the immense effect sand had upon the climate and scenic features of any neighbourhood. Sandy soils are dry and absorbent and do not promote much humidity in the atmosphere; they receive and part with heat more quickly than any other soils. This is well seen in parts of the great desert of Sahara, where the temperature reaches 150° F. in the daytime and falls to 20° F. at night.

Photography under Water.—The French Ministry of Marine has adopted an invention by which photographs of vessels sunk in deep water may be taken. This is effected by means of a camera worked by an electric incandescent light, and it is fully expected that the invention will also make the operation of divers much easier.

TECHNICAL EDUCATION NOTES.

PHOTOGRAPHIC COLLEGE.—Next March an institution for teaching photography in all its branches will by opened in Vienna under the directorship of Dr. Eder.

PARIS—A SCHOOL ÔF BREWING.—The Minister of Agriculture has ordered the immediate formation of "Laboratory Schools of Brewing, Distilling, and Sugar Making."

FRANCE.—A project for enabling rural schoolmasters to devote several hours a week to the teaching of agricultural science and agricultural account keeping is under the consideration of the Minister of Public Instruction.

SCHOOL BOARD EVENING CLASSES.—The evening classes established by the School Board for London in 1882 have each session greatly increased in number and in the effectiveness of their work. In the present session classes have been opened in no less than 128 schools, and more than 10,000 pupils have enrolled themselves. The subjects are varied as much as possible to meet the requirements of individual pupils, and are taught in an interesting and attractive manner. The Recreative Evening Schools Association, whose President is her Royal Highness Princess Louise, is rendering the Board great assistance in this work. The fee is, as a rule, only 3d. a week, and a great reduction is made if paid quarterly.

THE NIAGARA SUSPENSION BRIDGE.—A short time ago a very interesting paper was read by Mr. Buck before the American Society of Civil Engineers, describing the operation of replacing the old masonry towers of the Niagara suspension bridge by wrought iron towers. The original towers were ninety feet high on the American side, and eighty feet high on the Canadian side, the top of each being covered with a cast iron bed for the support of two cable saddles by means of interposed rollers. The masonry very soon after completion began to show signs of failure, attributed by the author to a bending strain from the elongation and contraction of the cables, which gave a movement to the saddles amounting to two inches from temperature and five-eighths of an inch from live load. These failures continued, and became alarming about two years ago, when it was resolved to substitute iron towers, the order being placed with the Detroit Bridge and Iron Works. Each tower is made up of four wrought iron columns braced transversely and longitudinally by wrought iron struts and rods, the base of the columns resting on a limestone pedestal capped with granite. As the cables could not be disturbed, it was necessary to retain the old saddles, and merely replace the support below and transfer the load to the new iron columns. This was done by means of a transferring apparatus consisting of six jacks raising a framework of short girders, to which the old saddles were lashed by steel wire, the core holes in the saddles being used for threading the wire through. Each jack was worked by a man, and after the saddles had been sufficiently raised, the lifting frame was shored up by cast iron columns and the jacks removed; the old base plate and about three courses of masonry were then removed, and a new built-up main bed, measuring nine feet by five feet, and three feet eight inches high, and weighing about nine and a half tons, was introduced, the ends resting on the girders connecting each pair of columns. The roller bed and rollers were then inserted, and the transferring frame was, by means of the jacks, again let down, so as to bring the weight on to the new main bed. The whole operation took eight and a half hours for each pier, no trains being allowed on the bridge while the transfer was being made.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE INTELLIGENCE OF BIRDS.

A grey African parrot, which I have the pleasure of knowing intimately, when she hears the doors being locked and bolted at night, always cries out emphatically, "Good-night," often adding, "Polly wants to go asleep," expressions which she never uses at any other time. If she sees the daughters of the house equipped for a walk, she very frequently asks, "Are oo going out?" Once or twice on seeing water drawn from a tap, she has cried out, "Water, water! Polly wants!" Now the fact of her uttering these phrases only when they are appropriate proves, in my opinion, that she rightly connects them with the several occasions. ARICOLA.

COLOUR SENSE OF ANIMALS.

Sir John Lubbock's attempt, to train dogs to distinguish and remember colours seem to have been unsuccessful. It will probably be found that in mammalian animals the colour sense is less developed than in birds. But horned cattle evidently possess some degree of the recognition of colour. It is well known that they, especially bulls, are moved to anger at the sight of any scarlet or bright red object. This fact proves, it would seem, that they can distinguish a bright red from the brown-reds so common in their own species. Has a bull ever been known to manifest anger at a field full of scarlet poppies? S. O.

SUN-SPOTS AND GRAIN PRICES.

One naturally asks the question after reading this heading, "What connection can exist between sun-spots and grain prices?"

It is an astronomical fact that there is a regular periodicity of the sun-spots; and physical observers have noticed the same periodicity in the variations of the earth's magnetism and in the brilliancy and number of auroræ. It is a question worth looking into whether the regular periodicity of eleven years in the sun-spots has any effect upon the value of agricultural produce, so eminent an authority as Professor Jevons holding that opinion.

Mr. Chambers, the Bombay meteorological reporter, has endeavoured to trace a connection between the recurring eleven years of sun-spots and the variation in the price of millet for every year of the last century in one of the larger provinces of India.

He expressed the prices in pounds-weight for a rupee, the number 125, for example, meaning that the number of pounds of grain for a rupee in that year was 25 per cent. greater than the corresponding eleven-yearly average. He arranged the years from 1783 in nine groups of eleven years each, and put down the numbers for the several years. On examining the table, we find years of high and low prices recurring with some regularity—five consecutive years being good years, when money prices were below the average, and the six following years being bad years when money prices were above the average.

Now, not only is there a regular period for the maximum of sun-spots, and a regular period for the maximum of grain prices; but these maximum periods coincide. Amid all the apparently irregular fluctuations of the yearly prices, there is in every one of the ten Indian provinces a periodical rise and fall of prices once every eleven years, corresponding to the regular variation which takes place in the number of sun-spots during the same period. The data, in fact, warrant the conclusion that if it were possible to obtain statistics to show the actual yield of the crops of each year, the eleven yearly variations calculated therefrom would correspond with

the sun-spot variation even more closely than the variations in price.

Following the regularity of each cycle there is some reason for believing that the present period of low prices following the last maximum of sun-spots which was in the end of 1882 and the beginning of 1883, will not last very much longer. These are the simple facts, and the coincidence is so striking that the subject is deserving of attention, and perhaps some of your readers may be able to throw some further light on the question. T. G. M.

ELECTRIC SEWAGE TREATMENT.

"S.P.E." asks in your last number if anything has been done for the purification of sewage by electric action. He will doubtless by this time, have seen mention of the novel project for purifying the sewage of London electrically. As the general idea is not novel, I should like to ask if any of the details of Mr. Webster's scheme have come to your knowledge. W.

THE LIFE-TIME OF THE SUN.

Some surviving opponents of Evolution seem to be elated at the calculations of physicists, which seem to fix 20 million years as the maximum time during which the sun can have existed. They would do well, however, to bear in mind that geologists and naturalists, generally speaking, attach very little value to such calculations; which, moreover, are sufficiently discordant. We see that the events which have taken place since the origin of the sun cannot have been compressed into such a comparatively short time. However accurate the mere details of the calculations may be, the fundamental assumptions are not proven, and there is always the possibility of unknown factors intervening.

VERAX.

BLOW-HOLES IN STEEL.—The presence of blow-holes in steel was, at one time, generally attributed to bubbles of carbonic oxide. More recently the investigations of Müller, Stead, and others have proved the cavities in steel ingots to contain nitrogen and hydrogen. Mr. W. F. Durfee has recently communicated to the United States Naval Institute an ingenious and somewhat novel view of the subject. He considers the blow-holes in ingots to be caused by air carried down into the mould by the stream of steel rushing out of the ladle. The action may be illustrated by holding a glass of water under a running tap, when the course of the bubbles may easily be seen. When the tap is turned off, the fluidity of the water instantly allows the bubbles to escape; but if the experiment be repeated with a more viscid liquid—melted gelatine, for instance—some of the air will be unable to escape. When the mass has solidified, the disposition of the bubbles will be found to be very similar to that of the cavities in a soft steel ingot. The temperature of molten steel is sufficient to expand air about seven times; while any atmospheric moisture would be converted into gases with corresponding increase of volume. So that a small quantity of air may produce a considerable degree of porosity. Mr. Durfee proposes to overcome the difficulty of producing sound ingots by making the steel sufficiently fluid to permit the escape of the air bubbles by the addition of a small quantity of aluminium. The improvement in fluidity, and subsequent solidity, resulting from the addition of less than 0·1 per cent. of aluminium to melted wrought iron or mild steel has long been known, and is practically taken advantage of in the manufacture of Mitis castings; but however beneficial, its application to ingot steel must in the meantime be limited to cases where cost is an entirely secondary consideration.—*Industries.*

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

PRESERVING MILK.—A new treatment of milk to prevent its turning sour has been patented by Mr. J. France, of Marsden, Yorkshire. The milk desired to be preserved is charged with carbonic acid gas, in the same way in which mineral waters are aerated, and then bottled.

SHIP'S LOG.—A log for indicating the speed of vessels by registering the same on a horizontal plate, has been patented by Mr. Rood, of Portswood, Southampton. It consists of a single spring balance, and a line of from twenty fathoms upwards. The plummet is towed in the water, and the log placed under the deck with a wire attached to it, leading to the trail line.

BILLIARD CUE.—Messrs. Dress and Weber, of Freiberg, Germany, have patented a billiard cue. In order that the cue may be able to retain its strength and rigidity, a metal tube is used, inserted into a thin wooden one of the proper size, the inner end of which is turned down and let into a recess in an outer wooden stick of suitable dimension, the inner end of which is itself inserted in a similar way and preferably screwed into the outer end of the butt of the cue, which is made hollow. Cues made in this way are not heavier than the ordinary solid ones.

REGENERATIVE HYDRO-CARBON LAMP.—Messrs. Chandor and Nölting, of Mark Lane, London, have patented a regenerative hydro-carbon lamp. This invention is a lamp, in which no glass chimney is employed. The air requisite for feeding the flame is led to the same from below in a highly heated state, while the products of combustion pass off by a special tube, which is so heated by the products of combustion passing through it that it serves to heat the air fed to the flame. By this means a pure white light is obtained consequent on the perfect consumption of the hydro-carbon employed.

APPLICATION OF ELECTRICITY TO COAL-CUTTING MACHINES.—An apparatus for transmitting motion to coal-cutting machines has been patented by Messrs. T. and R. W. Bower, of Blackburn, and F. Mori, of Allerton Main Collieries, Woodlesford. The improvements refer to the employment of an electro-motor for imparting motion to coal-cutting machines. For this purpose a dynamo machine of high tension is employed, from which the electro-motive force is imparted to a motor attached to the coal-cutting machine through suitable cables; between the motor and the dynamo, and in connection with the cables, a cut-off is employed to regulate the speed of the motor.

NEW GAS BURNER.—An apparatus for lighting by the consumption of gas and air is the subject of a patent by Mr. J. S. Sellon, of Hatton-garden, London. The gas

and air are admitted into a chamber mounted on a suitable stem, which is closed at the top by a disc of gauze or perforated material, which will resist the heat of incandescence, and which may be mounted in a frame of incombustible material, such as asbestos. Above this is amounted a chimney of glass or talc. The gas and air are received, mixed, and heated in the lower portion of the transparent chamber, and thence proceed to the gauze, through which (before ignition) they pass to the chimney, at which they are ignited, and thereafter the gas and air are consumed at the "gauze," and render it incandescent, so that it sheds a clear, steady, and intense light.

A Smokeless Furnace.—Mr. A. Schreiber, of Dresden, Saxony, has patented a smokeless furnace. This invention relates to furnaces fitted with transverse fire-bars and with an air-passage at the back of the furnace in front of the bridge. The front part of the furnace, for a short distance from the dead plate, is made level, from whence the bars are made to rise in a curve to the back of the furnace. The latter bars are also raised at their centres above the level of their ends, and the lower edges of their webs are curved forward for the purpose of assisting the entrance of air from the ash-pit. An inverted bridge is built in the flue a short distance behind the ordinary bridge, to deflect and mix the heated gases and render combustion more perfect.

Improved Means of Holding Comb Foundations in Bee-hives.—An improved means of holding comb foundations in bee-hives is the subject of a patent of Mr. J. W. Abbott. By this invention the comb foundations may be quickly and securely fixed in their frames in such a way that no harbour is afforded for the wax moth. The invention consists in cutting a double longitudinal groove in the underside of the top bar of the frame in which the foundation is to be suspended, the groove extending the whole length of the comb foundation. The double groove is formed by two parallel grooves, separated only by a parting strip so thin as to be flexible laterally. In the one groove is received the edge of the comb foundation, which just fills the groove, and in the other is driven a packing piece of wedge-shaped section, whereby the parting strip is clamped against the comb foundation, and the latter is tightly gripped in its groove, both grooves being thus completely filled up.

Electrical Fire Alarm.—Messrs. Petit and Bresson, of Vittoria, Spain, have patented an electrical fire alarm. The invention relates to apparatus which, when a sudden elevation of temperature occurs near it, makes or breaks electric contact, and thereby causes a signal to be given. For this purpose a bar of metal of considerable transverse section has stretched on it and in front of it a fine wire of the same metal. The middle of this wire is pressed against by a spring, and carries an electric contact piece either in or out of contact with conductors leading to an alarum. Upon gradual change of temperature both the bar and the wire expand equally, and the electrical contacts remain unaltered; but when there is a rapid elevation of temperature near the apparatus the wire expands more rapidly than the bar, and the spring pressing on its middle gives it such flexure that the contact piece which it carries is moved out of contact, thereby opening the electric circuit of the alarm.

ANNOUNCEMENTS.

The Smithsonian Institution.—Professor Samuel Pierpont Langley, LL.D., the assistant-secretary of this Institution, has been appointed secretary in the place of the late Dr. Spencer Baird.

Photographic Exhibition.—An exhibition of photographs and photographic apparatus and appliances will be opened in the Galleries of the Albert Institute, Dundee, on February 16th next. All communications should be addressed to the Secretary.

Geology.—Professor Bonney commenced on Wednesday last at University College a course of sixty lectures on Petrological, Physical, and Stratigraphical Geology. On Friday he commenced a course of about twenty lectures on Economic Geology.

Photographic Chemistry.—Professor R. Meldola, F.R.S., will shortly deliver a course of six lectures upon this subject at the Finsbury Technical College. The course will begin on Wednesday, January 18, at 7·30 p.m., and be continued on successive Wednesdays. Instruction will also be given in the laboratory in the testing and valuation of photographic chemicals.

Cambridge.—A grant, not to exceed £150, has been made from the Worts Travelling Scholars' Fund to Mr. M. R. James, B.A., Fellow of King's College, for the purpose of archæological research in Cyprus, Mr. Smith, of Trinity, to whom the grant was made on November 10th, being unable to undertake the journey. At Clare College there will be an examination on Wednesday, March 14th, 1888, when six scholarships, of values varying from £80 to £40, will be awarded provided properly qualified candidates present themselves. The scholarships will be awarded for Classics, or Mathematics, or Natural Sciences, and are open to the competition of persons who have not yet commenced residence in the University and are under nineteen years of age. The scholarships will be tenable for one year, but subject to extension or exchange for foundation scholarships. Candidates for a Natural Science scholarship are required to send their names, with testimonials of good conduct and certificates of birth, to the Rev. W. Raynes, Senior Tutor, on or before Saturday, March 3rd.

Royal Institution.—The following lectures have been arranged: Mr. G. J. Romanes, M.A., F.R.S., ten lectures—"Before and After Darwin"—on Tuesdays, January 17th to March 20th. Mr. H. Herkomer, M.A., A.R.A., Slade Professor of Fine Art in the University of Oxford, three lectures—on Thursdays, January 19th, "The Walker School"; January 26th, "My Visits to America"; February 2nd, "Art Education." Mr. C. H. H. Parry, M.A., Professor of Musical History and Composition at the Royal College of Music, four lectures on "Early Secular Choral Music, from the Thirteenth Century till the Beginning of the Seventeenth," with illustrations, on Thursdays, February 9th, 16th, 23rd; March 1st. The Rev. W. H. Dallinger, LL.D., F.R.S., three lectures on "Microscopical Work with Recent Lenses on the Least and Simplest Forms of Life," on Thursdays, March 8th, 15th, 22nd. The Right Hon. Lord Rayleigh, M.A., D.C.L., F.R.S., seven lectures on "Experimental Optics," illustrated by electric light, on Saturdays, January 21st to March 3rd. Mr. William Archer, three lectures on "The Modern Drama: French, Scandinavian, and English," on Saturdays, March 10th, 17th, 24th. The Friday evening meetings commence on January 20th with a discourse on "The Diffraction of Sound," by Lord Rayleigh.

Victoria University, Manchester.—The following appointments to vacant examinerships have been made by the Council:—

Chemistry.—A. V. Harcourt, M.A., F.R.S., Reader in Chemistry in the University of Oxford.

Engineering.—J. A. Ewing, B.Sc., Professor of Engineering in University College, Dundee.

English Language and Literature.—T. Arnold, M.A., Fellow of the Royal University, Ireland.

Geology.—T. G. Bonney, D.Sc., LL.D., F.R.S., Professor of Geology in University College, London.

German Language and Literature.—Franz Lange, Ph.D.,

Professor of German in the Royal Military Academy, Woolwich.

Mathematics.—H. M. Taylor, M.A., Fellow and Mathematical Lecturer of Trinity College, Cambridge.

Philosophy and Political Economy.—W. R. Sorley, M.A., Professor of Philosophy in University College, Cardiff.

Physics.—William Garnett, M.A., D.C.L., Principal and Professor of Mathematics, Durham College of Science, Newcastle-on-Tyne.

Anatomy.—G. D. Thane, M.D., Professor of Anatomy in University College, London.

Forensic Medicine and Hygiene.—G. V. Poore, M.D., F.R.C.P., Professor of Medical Jurisprudence in University College, London.

Obstetrics.—G. Ernest Herman, M.B., F.R.C.P., F.R.C.S., Obstetric Physician and Lecturer on Midwifery in the London Hospital.

Pathology.—Victor Horsley, M.B., B.S., F.R.C.S., Professor of Pathology in University College, London.

Physiology.—Augustus D. Waller, M.D., Lecturer on Physiology in St. Mary's Hospital Medical School.

Surgery.—A. Pearce Gould, M.B., M.S., F.R.C.S., Assistant Surgeon and Surgical Tutor in Middlesex Hospital, London.

DIARY FOR NEXT WEEK.

Monday, Jan. 23.—London Institution, at 5 p.m.—*Alexander the Great;* Rev. William Benham, B.D.
Aristotelian Society, at 8 p.m.—*The Philosophical Importance of a True Theory of Identity;* Mr. Bernard Bosanquet.

Tuesday, Jan. 24.—Royal Institution, at 3 p.m.—*Before and After Darwin;* Mr. G. J. Romanes.
Photographic Society, at 8 p.m.—*Technical Meeting.*
Mining Association and Institute of Cornwall, Redruth, at 2 p.m.—*Annual General Meeting.*

Wednesday, Jan. 25.—Society of Arts, at 8 p.m.—*Theatres and Fireproof Construction;* Mr. Walter Emden.

Thursday, Jan. 26.—London Institution, at 6 p.m.—*Architectural Mouldings;* Mr. H. H. Statham.
Camera Club, at 8 p.m.—*A Tour through Southern Spain;* Mr. Andrew Pringle.
Society of Telegraph Engineers and Electricians, at 8 p.m.
Royal Institution, at 3 p.m.—*My Visits to America;* Mr. H. Herkomer.

Friday, Jan. 27.—Society of Arts, at 8 p.m.—*The Public Health in India;* Mr. Justice Cunningham.
Institution of Civil Engineers, at 7.30 p.m.—*Pumping Machinery in the Fenland and by the Trentside;* Mr. Lawrence Gibbs.
Royal United Service Institution, at 3 p.m.—*The Pneumatic Dynamite Gun;* Capt. H. de H. Haig, R.E.
Royal Institution, at 9 p.m.—*The Exploration of Masai Land;* Mr. Joseph Thomson.
British Museum, at 2.30 p.m.—*The Hittites;* Mr. T. Tyler.

Saturday, Jan. 28.—Royal Institution, at 3 p.m.—*Experimental Optics;* Lord Rayleigh.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. Morgan, Chemical Engineer, Gloucester.

Horizontal Engine, 8 horse-power Pumps and Governors. Complete, £25. A bargain.—W. H. Morgan, Engineer, Gloucester.

Books.—All kinds supplied. "Sprague's Electricity," new; 12s. 6d., post free.—Parker, 160, Great Hamilton-street, Glasgow.

Before deciding, send 2d. for list of Second-hand **Lathes, Fret-saws, Mechanics' Tools.**—Britannia Co., Colchester. Makers of Engineers' Tools to the British Government.

Large assortment of **Tools,** etc., on view, 100, Houndsditch, London.—All letters to Britannia Works, Colchester. *Bona-fide* makers of 300 varieties.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased; Ambers fitted.—W. George, 324, Essex-road, Islington, London.

"Playground of Science," just ready, containing novel, simple, and interesting scientific experiments, illustrated. One Shilling, post free.—Truslove and Shirley, 7, St. Paul's-churchyard, London.

Scientific Apparatus and Books, the property of a science teacher (deceased), for sale. In good condition.—Mrs. Walbourn, 15A, Anson-road, Tufnell Park.

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Micro-polariscope.—Well-mounted Slides of gorgeous crystals, 6d. each; 5s. a dozen.—Henry Ebbige, Framlingham, Suffolk.

Handsome (Old Italian Model) Violin, splendid tone, in perfect condition, with silver-mounted bow, and brass mounted, baize-lined, lock-up case; sacrifice the lot. Carriage paid, 17s. 6d., worth treble (approval). Also **Old Violoncello,** 160 years, 40s.—A. Gilders, Oyster Merchant, Brightlingsea.

Poultry, Pigeon, and Rabbit Nest Pans, Water Fountains, Feeding Troughs. Illustrated list free.—Pratt, Stoneware Works, Dudley.

Compound Slide Rest Castings, planed all over; 2½ in. 6s.; 3 in. 7s. 6d.; 3½ in. 11s.; 4. in. 14s.; 5 in. 24s.; 6 in. 30s.; Tracings, 6d. Particulars from Mr. Gladstone, Engineer, Stafford.

Gilding and Plating Taught.—Perks, 47, Alexander-road, Richmond, Surrey. 20 years practical experience with leading firms.

Soldering without Heat.—Process warranted practical; full detailed instructions, 7d. Returned if dissatisfied.—Stanley, 5, Bielsen-street, Poplar. Hundreds other valuable trade secrets. List free.

Minerals, or Lias, or Carboniferous Fossils.—12 named specimens, 2s. 6d., free.—C. Wardingley, 30, Blackwood-crescent, Edinburgh.

Crayon Sketch from any photo (returned uninjured), correct likeness, 15 in. by 11 in., 1s. each. Postage of one or more, 2d.—Mr. Coulthard. Bathwick, Bath.

Mechanics' Specialities.—20 large sheets, Fretwork Patterns, 7d.; 200 Twining Patterns, 1s.; 300 stencils, 1s.—Below.

50 Conjuring Tricks, 1s.; 100 experiments, 1s.; Photos, 100 eminent women, 1s.—Collins, Summerlays Place, Bath.

Saccharine.—300 times sweeter than sugar. Sample, 1s., post free.—Adlington, Broughton Fields, Worcester.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—Butler Bros., 44, Elsden-road, Tottenham, London.

BOOKS RECEIVED.

"The Commonhealth," Richardson (Longman and Co.).—"The Young Collector's Handbook; Ants, Bees, Wasps, Flies, etc.," W. H. Bath (Swan Sonnenschein and Co.).—"Weather," Abercromby (Kegan Paul and Co.).—"Transactions of the Institution of Engineers and Shipbuilders in Scotland."—"A Manual of Orchidaceous Plants," Parts I. and II. (Veitch and Co.)—"Morphology of the Carinæ," M. Holmes (Bradlee Whiddon).—"Story of the Niger" (Nelson).—"The Earth's Story," Dr. Brown (Cassell).—"Pictorial Geography of the British Isles," Mr. E. Palgrave (S.P.C.K.).—"Journal of the Camera Club."—"The Analyst."—"Autobiography of an Acorn, etc," J. Crowther (Sunday School Union).—"First Year of Scientific Knowledge," Madame Paul Bert (Relfe and Sons).—"Studies in Philosophy," J. Lightfoot (Blackwood).—"The Eskimo Tribes," Dr. H. Rink (Williams and Norgate).—"Journal of the Society of Chemical Industry."—"Year Book of Photography," T. Bolas (Piper and Carter).

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 4. (*New Series.*) JANUARY 27th, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

A CHAIR OF DARWINISM AT PARIS.—It is announced that the Municipal Council of Paris has resolved to found a chair of philosophical zoology with the more particular purpose of elaborating and popularising the doctrine of evolution. Whether the new professorship will be in connection with the Jardin des Plantes, the Sorbonne, or the Collège de France is a point not yet decided. This, as a valuable contemporary calls it, is an "enlightened, patriotic, and high-minded initiative." It is the more opportune as the Zoological Section of the Academy of Sciences has been the last entrenchment of the old school in natural history. We are here reminded that in England Professor Flower (the head of the Natural History Department of the British Museum) is being denounced in a certain quarter for spending national funds in teaching Darwinism!

THE CORAL REEFS CONTROVERSY.—Concerning the origin of these reefs a somewhat acrimonious controversy has arisen, and has in all likelihood not reached its conclusion. It is well known that, according to Darwin, coral reefs originate in the coral working around the shores of an island as it is gradually subsiding, and become first fringing reefs, then ring-atolls, at first with an island in the centre, which is ultimately submerged. About eight years ago Mr. John Murray, of the *Challenger* staff, presented a theory in which the phenomena of coral-reefs were to a great extent said to be due to elevation. This theory was freely discussed among geologists, both in Europe and America, and an abstract of it was read before the Royal Society of Edinburgh. But last year the Duke of Argyll published a paper in the *Nineteenth Century*, entitled "A Great Lesson." Here he intimated pretty plainly that Mr. Murray's theory had been suppressed, by a "conspiracy of silence," in which the late Sir Wyville Thomson was said to have taken a prominent part! To this Professor Huxley has replied, pointing out with beautiful neatness the inaccuracies of the Duke.

THE INJURIOUS CHARACTER OF AIR EXPIRED BY ANIMALS.—Attention has lately been drawn to living, and especially sleeping, in crowded and ill-ventilated apartments as a main cause of pulmonary consumption. This question has been confirmed by some interesting researches by MM. Brown-Sequard, and Arsonval which have appeared in the *Comptes Rendus*. These physiologists find, by direct experiment, that the lungs of man, of the dog, and of the rabbit, even when in a state of perfect health produce a very decided poison which is constantly given off in the air expired. It is extremely probable, if not certain, that this is the agent which renders a confined atmosphere so dangerous. It was found by special experiment that the increased proportion of carbonic acid in such air does not produce the special effects which are always observed.

THE TECHNICAL EDUCATION MEASURE.—Mr. Stanley Leighton has written an important letter on the two main departments of education. He urges that foreign languages and all subjects which belong to the secondary or technical department should be eliminated from the Board School programme. He holds that technical education should not be entrusted to School Boards or to

the voluntary managers of elementary schools. Not only are their hands already too full, but experience shows that School Boards often represent the denominations or the political clubs of the districts to the exclusion of practical men who know and care most about education. Politics and denominationalism have nothing to do with technical instruction. As a second principle he insists that the rates shall not be the source from which the technical schools must draw their supplies.

The Inundation in China.—The past autumn has witnessed the most disastrous inundation recorded in modern history. The vast and rapid river Hoang-ho has burst its embankments at a point about 300 miles from the sea, made itself a new channel, and submerged in one district alone 1,500 villages. The number of persons drowned in the province of Honan is estimated at from one to two millions, but a European resident in Pekin and coming in contact with high officials considers that it may reach seven millions! Multitudes more along a tract of 400 miles are left homeless and destitute, and many of them must by this time have perished. This catastrophe should be an impressive lesson on the necessity of keeping the uplands about the head waters of rivers as forests, and further it is a warning that the beds of streams should be kept clear by dredging instead of attempting to bank the water in with dams. Every river which is allowed to flow at a level higher than that of the surrounding country is a standing menace.

Singular Explosions.—The town of Rochester, in the State of New York, has been the scene of a novel calamity. The "Vacuum Oil Company" supplies the gas works of the town with naphtha, which flows along a pipe two miles in length, passing through the midst of the town. The supply suddenly ceased, though the Oil Company maintained that they had pumped 14,000 gallons on that day. On examination it was found that the tube had burst, so that all the naphtha had found its way into the sewers. Here it took fire from some unknown cause. Flames burst through the pavements of the streets, and there occurred a number of explosions, producing much injury and several fatal accidents.

Bricklaying in Winter.—In Norway building operations are carried on without interruption through the winter, unless the temperature falls lower than 14° to 18° Fahrenheit. The whole secret of the matter is that the Norwegians buy their lime, not slaked, but only burned, and, like the ancient Romans, mix their mortar only in small quantities for immediate use. The bricks are kept under cover prior to use, and the upper courses of bricks which have been laid are shielded from rain or snow by means of planks and mats during the night or whenever work is suspended. By attending to these simple precautions building operations can be carried on through the winter, to the benefit of all concerned.

The Cattle Diseases of the past Year.—Among the events summarised at the conclusion of 1887 the diseases among live stock cannot be overlooked. No widespread outbreak of cattle plague has, indeed, taken place, but pleuro-pneumonia among horned cattle and swine-fever continue to exist, and add to the burdens of agriculturists. There have been 272 outbreaks of pleuro-pneumonia in England and 314 in Scotland. Cattle actually attacked were slaughtered to the number of 2,322, whilst 3,245 head were killed for fear of infection.

The least satisfactory feature here is that, in spite of all remedial measures, pleuro-pneumonia is still steadily increasing, that the annual number of cases has nearly doubled itself since 1884. Swine-fever has also reached a point higher than had been known before, the number of outbreaks having been 7,000. Anthrax has occurred in forty-nine counties in England and nine in Scotland. The "stamping-out" system is not calculated to be here successful. There have been 500 cases of rabies in twenty-two counties in England, affecting dogs, horses, cattle, sheep, swine, and deer. Of the last-mentioned animals 200 head have thus perished in Richmond Park.

Electric Quackery. — The *Lancet* and the *Electrical Review* are labouring to expose the electro-medical quackery which is believed to be carried on upon an enormous scale. It is said that £20,000 a year is spent on producing and advertising fraudulent appliances by persons as ignorant of electricity as they are of every branch of medical science. The undoubted fact that electricity under proper conditions and in skilled hands is a therapeutic agent of great performance and still greater promise has opened the door to this advertising quackery, and, unfortunately for scientific medicine, people in general are unable to discriminate between the one and the other.

The Future of Public Health.—Under this heading Dr. C. A. Gordon writes to the *Medical Press*, pointing out certain facts which seem to show that, in spite of any increase of stature and of longevity, there are in our race indications of degeneration. The standard height for military service has been reduced, the ratio of rejections for bodily disability among recruits has risen considerably, and those who are accepted seem lacking in that robustness which characterised their predecessors many years ago. In civil life also it is now increasingly difficult to obtain men fit for the heavier kinds of labour. The facts are that we and other civilised nations are in many ways striving to ensure the "survival of the unfittest."

HOT AIR STOVES.

HOT air stoves are not nearly so extensively used in this as in other countries. This is partly due to a preference for open grates, and partly to the more extended use of hot water circulated in pipes; but also largely to the dislike of any system which heats the air excessively. There are, however, two classes of hot air stoves, one in which the air is heated by coming in contact with the external surface of the stove, the other in which the air is heated chiefly by sweeping through passages in the interior of the stove. In the former the heating surface is comparatively small, and as the economical working of such a stove generally involves heating the air to a much higher temperature than comfort and health require, the objection to it is not founded on mere unreasoning prejudice. For domestic use we may say at once that we consider highly-heated close stoves most unsuitable, even when pans of water are used to supply moisture to the air. We have no wish to exaggerate the importance of this question, but the ventilation of a room is, or ought to be, so intimately associated with its heating, that we cannot refrain from mentioning certain well-known facts. As we pointed out on a former occasion,* our comfort depends greatly not only on the warmth of the air we live in, but on its feeling sufficiently dry or moist, as the case may be. By this it must not be supposed that the quantity of

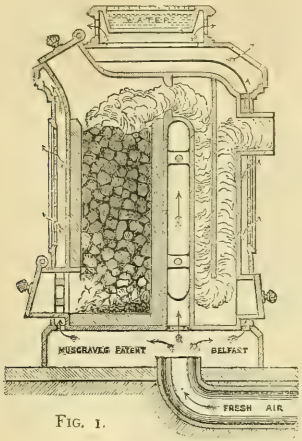


FIG. 1.

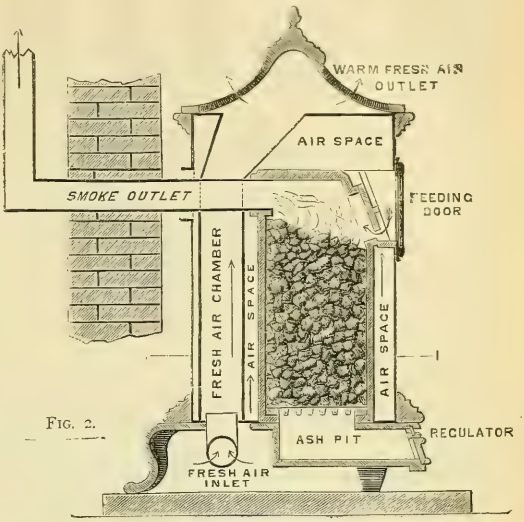


FIG. 2.

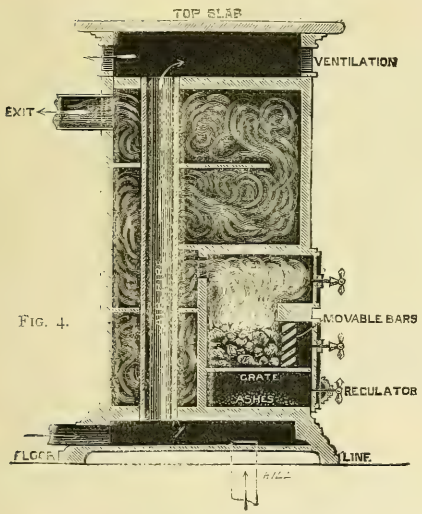


FIG. 4.

SECTION AT I.I.

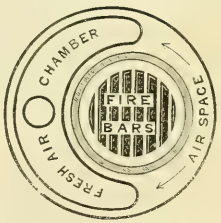


FIG. 3.

* *Vide* Old Series, No. 3, p. 59.

moisture is increased or diminished, but that the capacity of air to absorb moisture is increased when the temperature is raised. Our judgment is, in fact, independent of the actual quantity of moisture present, and in summer or winter we talk of the air being either dry or wet, not because there is any difference in the quantity of moisture present, but because in summer the capacity of the air to absorb moisture is greater, whereas in winter the atmosphere is nearly saturated. According to Mr. Leslie, its capacity for moisture is about doubled for every increase of twenty-seven degrees Fahrenheit. For this reason when air is overheated, without being brought sufficiently in contact with water, it too rapidly absorbs moisture from our skin and lungs, and this withdrawal of moisture has a cooling effect. Moreover, according to Dr. Urc, the blood-vessels on the surface are then contracted, while other parts of the body, not being exposed to such an influence, are surcharged with the fluids repelled from the extremities. Then, again, there is the fact that the decomposition of animal and vegetable matters given off from the lungs and skin is more readily effected when the air is hot. It will thus be seen that there are many and good reasons why the air of the rooms we live in should not be rendered too hot or too dry, and that it is essential to accompany any system of heating with efficient means of ventilation, to insure a good supply of fresh air and sufficient moisture to give a feeling of comfort to those present.

Formerly churches and large buildings were often heated by means of pipes conveying either hot air or the hot products of combustion from a fire, but in nearly all cases in this country such a system has been abandoned, partly for the reasons above stated, partly because of the difficulty of obtaining a uniform temperature, and partly because of the risk from fire owing to the overheating of pipes. A circulation of hot water is now generally used instead, as with this the temperature of the pipes can never exceed 200° F., and it can be reduced below this exactly as required.

There remains, however, the class of stoves in which the air of the room is heated by allowing it to pass through chambers provided in the stoves. In this system the objections to close stoves are to a great extent removed, and may be entirely overcome if care be taken not to over-heat the stove, and to provide a pan of water on the top of the stove to prevent excessive dryness of the air. Typical examples of these stoves are given in the accompanying illustrations,* and it will be seen that if the air to be heated is taken from the outside of the building, these stoves may be made to materially assist healthy ventilation. Fig. 1 represents a slow combustion stove fed with fuel from the top, and with an external casing enclosing an air space. There are also air cells in the middle of the stove, and inlets for air at the bottom and outlets at the top, all the air spaces being indicated by arrows. In this stove the air of a room can be made to enter at the bottom and discharged at the top, and the same air can be heated over and over again. But a still better way is to connect the bottom of the stove with a fresh air supply taken from the outside of the building, as shown in Fig. 1, so that a continuous current of fresh warm air may be delivered into the room. This stove is much used for hospitals, for the halls of houses, and for churches and school-rooms. In Figs. 2 and 3 we have the vertical and transverse sections of another stove similar in principle; and the makers very properly point out that it is most desirable to let the air inlet at the bottom be in direct communication with the external air. Such a stove need only be charged with small coke once in ten or twelve hours. Fig. 4 is another example of a close stove with means of heating air passing through it, and here we see that the air supply is drawn from a passage through the floor of the room. In this case the internal and external parts of the stove are made of fire-clay tiles, iron being used only for bracing the various parts together and for the doors. With this construction it is more easy to maintain a uniform temperature, as the fire-clay, being a refractory material and a bad conductor of heat, does not cool quickly, even if the fire is neglected and gets low; nor is it easy to overheat it. As, therefore, the fire-clay does not get too hot, and as it is a bad conductor of heat, the air passing through and over it does not get excessively dry, if suitable arrangements are made. On the other hand, the very fact that fire-clay is not so good a heat conductor as iron, renders the latter more economical to use, although less easy to regulate. A good example of the fire-clay stove has been fitted up in the Smoking Room of the Hotel Métropole, and in this case four stoves are, so to speak, made into one. In other words, the stove has four fires—one on each side.

* We are indebted to Messrs. Musgrave and Co. for Fig. 1; to Messrs. J. F. Farwig and Co. for Figs. 2 and 3; and to Messrs. Doulton and Co. for Fig. 4.

Gum Trees.—The rapid growth and the value as timber and fuel of many of the Australian gum trees (eucalyptus), have induced planters in this country to attempt their cultivation; but the experiments have proved beyond question that none of the species is sufficiently hardy to bear the winters of the eastern and central parts of this kingdom. In some localities they escape injurious effects during a cycle of comparatively mild winters, giving rise to hopes that they are permanently established; but a colder winter, or a cold, wet autumn, followed by an ordinary winter, kills, or irremediably injures the young trees. Of the many species tried at Kew, for instance, only one, Eucalyptus Gunnii, has lived through many years without some kind of protection, and the young shoots of this have often been destroyed. A tree of Eucalyptus Gunnii, which for many years bore the incorrect name of Eucalyptus polyanthema, stood, some thirty years ago, near the old Mesembryanthemum house, near or on the site of the present Orchid house, and many will remember it as the first Australian tree they had seen growing in the open air in England. It was then perhaps about 20 ft. high, and, so far as we remember, it was not materially injured by the intense frost of 1860-61, when large specimens of Cupressus macrocarpa and Pinus insignis were killed outright. That season the thermometer fell, on two or three occasions, below Zero at Kew, where, if we remember rightly, it has never since been so low. Some years later, when the new range of houses was built, the alterations necessitated the removal of this tree, and it was transferred to the western slope of the mound on which the Temple of Æolus stands, near to No. 2 Museum, and the result was that it died to the ground, or nearly so; but, what was surprising, it threw up new stems, and is still flourishing. —*Gardeners' Chronicle.*

IRON CURTAIN FOR THEATRES.

AS a rule the stage and the auditorium of theatres are practically two distinct buildings, the only communication between them being the large opening through which the performance is observed. As fires usually break out upon the stage, a prompt and effectual method of hermetically closing this aperture is required. Curtains made of asbestos cloth or of wire gauze would permit the passage of the products of combustion into the auditorium and cause death by suffocation. Sheet-iron curtains have been suggested for this purpose, but their weight, about 20 tons, is very considerable, and although it would be comparatively easy to suspend a curtain so that it should fall the instant a catch was removed, yet there would always be doubt as to whether the screen would be in working order at the moment it was needed. What, therefore, is required is a curtain which can be used with certainty, and at all times required. M. Edoux, a French engineer, has overcome the various difficulties, and has fitted easily movable iron screens to some of the theatres in Paris.

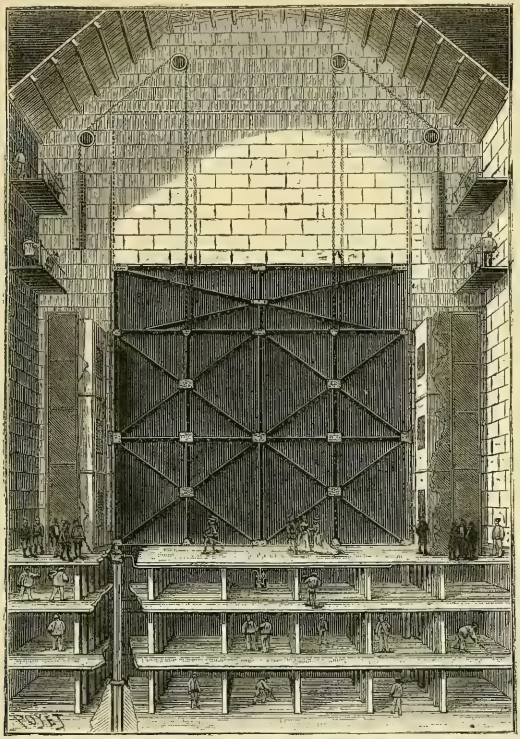
Our illustration, taken from *La Nature*, shows the way in which he has solved the problem.

The curtain is made of strong sheet iron attached to a cast-iron frame. It is made in two pieces; one is fixed above the top of the proscenium, while the other, which forms the true curtain, slides behind it. This portion is raised or lowered at will by means of two hydraulic presses, one of which is drawn on the left of the illustration.

In order to take some of the strain off the hydraulic pumps, the screen is nearly balanced by means of counterpoise weights. A shaft should, however, be made for these weights to travel in, as otherwise serious accidents might occur should a chain by any chance happen to break.

The water supply for working the presses may either be supplied direct from the main, from a cistern on the roof, or from a hand-pump placed below the stage.

The taps for emptying them can be placed below the stage and may be controlled electrically from any part of the house, or, if thought preferable, electric wires may be arranged in the "flies," in such a way that as soon as a fire occurred their insulation should be destroyed, and they should automatically complete the circuit, and so turn on the discharge tap. At the Théâtre-Français the iron screen is lowered at the end of each



IRON CURTAIN FOR THEATRE.

act; in front it is covered with painted canvass, which gives it the appearance of an ordinary drop-scene. We trust that similar screens will be introduced at all the theatres in England.

HOAR-FROST AND FOG.

MR. JOHN AITKEN, of Darroch, Falkirk, has contributed to the Proceedings of the Royal Society of Edinburgh, an interesting note on the formation of hoar-frost. Hoar-frost is generally described as frozen dew, and is supposed to be deposited in the same manner and under the same conditions as dew,* the only difference being in the temperature at which it is deposited. Though in a general way this may be so, yet there are certain differences in the conditions and the manner in which the vapour is condensed at the various temperatures, which he has brought before the Society.

If a surface, such as a sheet of glass, be exposed horizontally near the ground on a dewy night, the windward edges are generally found dry. This indicates that the air itself is not cooled to the dew point, though the surfaces of bodies exposed to radiation are, and the air has to travel some distance over the cold surface before its temperature is reduced to the dew-point. If, however, the same surface be examined when the temperature is low enough to cause the deposited moisture to form hoar-frost, a marked difference is frequently found. The sheet of glass is generally not only covered with the deposited vapour up to the windward edges, but the deposit is heaviest along these edges, the ice-crystals growing furthest out in that direction. This peculiarity in the deposition of hoar-frost may also be observed on almost all objects—such as branches of trees, iron fences, &c. The heaviest deposit will often be found on the windward side, and not on the top, where it might be expected, owing to the stronger radiation from that surface.

He has investigated the cause of the difference between the deposits of dew and hoar-frost. The dryness of that part of the dewed surface where the air first touches it is caused by the air not being saturated, and requiring to travel some distance over the cold surface before it is cooled below its dew-point. When, however, frost is forming, the air seems generally to act as if it were supersaturated; the crystals growing most towards the wind seems to indicate that the air does not require to be cooled before it deposits its moisture. Now, under ordinary conditions, it is impossible for the air to be supersaturated. Owing to the vast amount of dust in the air, there is always plenty of free surface present to prevent supersaturation, so long as the temperature is above 32° Fahr. But when the temperature falls below the freezing point, a much more complicated state of matters is presented.

It has been found that ice and water have the same temperature at 32°, under a pressure of 4·6 mm.; but when the pressure is about 3·20 mm. the water is at a temperature of about 23° while the ice is about 24°. Thus with the reduced pressure the water is about a degree colder than the ice. If then the ice be cooled to the same temperature as the water, its vapour-pressure will be less than that of the water, and if a water-surface and an ice-surface be near each other at the same temperature, vapour will tend to pass from the water to the ice. As the vapour-pressure of the water is higher than that of ice, the air which is saturated to a water-surface is supersaturated to an ice-surface.

Something like this seems to take place when hoar-frost is forming. When the air is cooled, condensation takes place on the dust particles, resulting in a fog. This moisture condensed in the air seems always to keep the liquid form; though during frosty weather the fog is intensely cold. In the fogs formed low down in the atmosphere there are no optical or other phenomena such as might be expected if the particles were frozen. Thin films and small drops seem difficult to freeze. It is not unusual to see a liquid film on the night-radiation thermometer, although the instrument is reading many degrees below the freezing-point. Accordingly fog particles in frosty weather may be found liquid, and the pressure of the vapour in the air, as it corresponds to that of a liquid surface, will be greater than that of an ice one at the same temperature. Under these conditions, the air will rapidly unburden itself of part of its vapour when it comes into contact with an ice-surface. This is why hoar-frost grows in the direction from which the air is moving; because the air, being supersaturated, unburdens itself on the first ice-surface with which it comes into contact. On the other hand, when the dew is forming, it requires to be brought into a condition to cause it to give up its vapour, which is done by travelling over the cold surface.

Mr. Aitken has never observed a heavy deposit of hoar-frost when the sky is clear, or in those conditions in which the heaviest deposits of dew are formed. On all those occasions on which trees and every exposed surface become clothed in hoar-frost, the transformation is always accomplished in a thick and foggy atmosphere. This bears out the explanation which he has given. On thick and foggy nights, little or no dew could be deposited, because the radiation would be checked by the fog. But on these very nights heavy deposits of hoar-frost are most likely to be formed, because the air has a large amount of vapour in it. Further, while dew requires that the surface on which it is deposited be cooled by radiation, this is not so necessary in the formation of hoar-frost, because the fog-particles radiate and cool the air to the saturated temperature of vapour at a water-surface, and the passing air discharges part of its vapour on all ice crystals or other nuclei with which it comes in contact; the passing air at the same time absorbs the heat of crystallisation, while the heat of condensation is balanced by the heat absorbed by the evaporation from the water particles. Accordingly hoar-frosty nights do not correspond to dewy nights (when the temperature is higher), but to those nights when every object is wet and dripping with deposited fog-particles.

* SCIENTIFIC NEWS, Vol. I., Old Series, p. 67.

SPECIAL METAL FOR BEARINGS.—Owing to the great rise in the price of tin, Babbitt's metal, when made according to the original formula, now costs proportionately more. Taylor's metal, made by Messrs. Osborne and Co., is not, however, affected in price, and it answers the same purpose as the Babbitt's.

CELLULOID FOR COATING SHIPS.—A new application has been found for celluloid, for, according to the *Annales Industrielles*, it can be used as a sheathing for ships instead of copper. Sheets of celluloid after being attached to vessels for five to six months were, on examination, found to be unaltered and quite free from the marine vegetation growing freely on the unprotected parts of the ships. The celluloid can be supplied in very thin sheets, its colour is practically unchangeable, and its impermeability is also in its favour.

General Notes.

THE UTILISATION OF FOOD.—According to Professor von Gohren different animals convert very unequal proportions of the potential energy of their food into energy available for mechanical work. A horse may thus transform 32 per cent., an ox 43 per cent., and a man 53 per cent.

SPECTROSCOPY.—Prof. A. E. de Nordenskiöld points out, in the *Comptes Rendus*, that at least in the spectra of certain simple bodies, the differences between the logarithms of the wave-lengths of each element are simple multiples of one and the same number.

PHOTOGRAPHY AND METEOROLOGY.—M. J. Janssen has recently read a paper on the application of photography to meteorology before the Academy of Sciences at Paris, and he exhibited photographs of meteorological phenomena taken on the summit of the Pic-du-Midi.

THE INTERNAL TEMPERATURE OF GLACIERS.—MM. E. Hagenbach and F. A. Forel, in a communication to the French Academy of Sciences, show that the internal temperature of the glacier Arolla is below freezing point, a fact due to pressure, which reduces the melting-point of ice.

ELECTRIC LIGHTING OF BUOYS.—Successful experiments in connection with the electric lighting of buoys by means of glow lamps fed by cables laid from the shore, have been carried out by Lieutenant Willis, of the American Lighthouse Department. Each buoy is illuminated by a 30 candle power glow lamp.

THE RE-BOUNDING OF A METEORITE.—In the *Comptes Rendus* we find an account of a meteorite which is said to have struck the earth at Than-Duc, and to have rebounded so as to disappear. The track made in the soil, and the fact of *two* sounds being heard, a loud crack followed by rumbling which gradually died away, are taken as confirmation that such was actually the case.

PROPOSED NEW METEOROLOGICAL STATION.—At a recent meeting of the French Meteorological Society a proposal was made for the establishment of a meteorological station at Bagnères-le-Bigorre. This station is important from its position at the foot of the Pic-du-Midi, being about 7,540 feet below the mountain observatory. —*Nature.*

NAPHTHA GAS.—As an experiment, one of the main thoroughfares of St. Petersburg is to be lighted with this gas burnt in a large lamp of special construction. This gas is said to give a more brilliant light than coal gas, and as its cost is three times less than that of coal gas and twenty-three times less than lighting with candles, the economy to be effected should be very considerable.

THE GREEK ALCHEMISTS.—Professor Berthelot has published the first portion of a work on the Greek alchemists. It contains a translation of the alchemical papyri of Leyden, the oldest known monument of chemical science. He further notices the supposed mystical relations between the metals and the planets, the spheres of the astrologist physicians and the alchemical symbols and notations.

HOT WATER FROM UNDERGROUND.—At Buda-Pesth, a well which has been bored to a depth not previously reached, now yields daily 176,000 gallons of water at 158° Fahrenheit. The attempt will be made to bore until the temperature of the water reached is 176° Fahr. Whether it will be possible in this manner to heat dwellings, churches, conservatories, and indeed gardens, is still an open question.

A NEW DECOMPOSITION IN WINES.—According to M. Bardas (*Comptes Rendus*), a new disease in wines has broken out in the vineyards near Algiers. It is occasioned by a special ferment which turns the wine into acetic acid, mixed with lactic acid, and this with such rapidity that in a very short time the wine is unfit for drinking. The colour of the wines is not affected.

SMOKE ABATEMENT.—A patent for a new smoke-abating process has recently been taken out by Herr Fischer, an Austrian engineer, who proposes, by means of electricity, to condense the solid part of the smoke as it arises from the coal, the carbon thus solidified falling back into the furnace. We cannot but be somewhat sceptical as to the possibility of so sanguine a proposal.

LEAD IN DRINKING WATER.—The Sheffield Corporation, in taking over the water supply of the town, finds that it has bought the task of dealing with an epidemic of lead-poisoning, which is experienced in some of the higher districts of the borough. One of the two sources of the water supply, which, from its altitude, is available in the more elevated districts, is found to contain vegetable acids which act on lead.

THE READING-ROOM OF THE BRITISH MUSEUM.—During the year 1887 the number of new admission tickets issued was 3,799, being an increase of 156 on the previous year. The number of readers using the room was 182,778, or 5,885 more than in 1886. The daily average of readers has increased steadily from 445 in 1881 to 603 in 1887. The average time taken to supply a book asked for is now sixteen minutes.

THE ELECTRIC TREATMENT OF SEWAGE.—Mr. W. Webster has devised a process for the purification of sewage and waste waters by electrolytic action. Powerful electric currents are to be passed into the polluted waters, when the impurities, whether existing in suspension or solution, will, it is said, be precipitated by the action of the current, aided by the chemical salts created by the same action upon the electrodes. The full details of the process are not yet before the public.

REMOVING RUST FROM IRON.—Iron may be effectively freed from rust by immersion in a nearly saturated solution of chloride of tin. The duration of the immersion will depend upon the thicker or thinner film of rust; in most cases, however, twelve to twenty-four

hours will suffice. The solution of chloride of tin must not contain too great an excess of acid, otherwise it will attack the iron itself. After the articles have been removed from the bath, they should first be washed in water, then with ammonia, and dried as quickly as possible.

Rubber Tubing.—Very elastic caoutchouc tubing gradually loses some of its elasticity. Later, the tubes break on stretching, even if previously laid in warm water, and, finally, they crack if pressed between the fingers. This change is put down to a very slow formation of sulphuric acid by the action of moist air on the sulphur contained in the caoutchouc. By frequent washing with alkaline water, the action of the acid is prevented. Tubes washed five or six times a year remain perfectly elastic.

Danger from Perforated Iron Masts.—In a recent case of spontaneous combustion on board a ship laden with coal, flames were seen issuing from the heads of the fore and main masts. These were made of hollow iron, and for the purpose of ventilating the hold they had been fitted with perforations below deck. Consequently, as soon as fire broke out in the hold, these masts acted like chimneys, and greatly increased the fury of the fire. It will therefore be necessary to devise some method of closing and opening such ventilators at will, so as to cut off the draught.

Alumina naturally present in Wheat.—Mr. Rashida has recently communicated to the Chemical Society a paper on "Aluminium in the Ash of Flowering Plants," showing that alumina is a normal constituent of wheat and the other cereals. This interesting question has been recently re-examined by Mr. W. C. Young, F.C.S., who not only confirms the results of Mr. Rashida, but shows that the whole of the alumina in wheat is contained in the gluten. This is an important fact, since it has been generally concluded that alumina did not at all enter into the organism of the higher plants.

Contamination of Current Coins.—Medical contemporaries maintain that, of all metals, bronze takes up and retains filth most readily, and prove their point by reciting a number of the conditions, unappetising, if not positively dangerous, to which money generally, and bronze pieces in particular, are exposed. We believe that in the last century the "wits" and the "beaux" received their change at fashionable taverns and coffee-houses in washed silver, but no such precautions are adopted in these days of hurry. We must, however, particularly caution our friends never to hold any piece of money in the mouth.

Famine and Sun Spots.—The Indian Meteorological Department has published a report, in which Mr. Blanford, head of the department, discusses the theory, first started during the Madras famine ten years ago, that famines tend to recur in Southern India at periods when the sun's spots are at the *minimum* of size and frequency. Mr. Blanford comes to the conclusion that there are no sufficient coincidences to support this theory. Nevertheless, he says, droughts of more or less severity do visit parts of India not liable to the influence of cyclonic disturbances at intervals of ten or eleven years, and the reason cannot be conjectured satisfactorily. The droughts in Northern India are less regular than those in Southern India, and they have been observed to be preceded by a heavy snowfall in the North-Western Himalayas.

The Lowest Observed Temperature.—The Russian Government some time ago established a meteorological observatory at Werchojansk, to the east of the Lena, the coldest district in the empire, according to the isothermal charts. The lowest temperature recorded there was, prior to the establishment of the observatory in December, 1871, when the thermometer recorded $-63{\cdot}2°$ Centigrade, which was then the lowest temperature recorded in the world. On the 3rd January, 1883, the alcohol thermometer registered $-68°$, as the mean of the month, the lowest on record being $-52{\cdot}7°$. On reducing the temperature recorded by the air thermometer to that of the alcohol thermometer which had been verified at the Central Physical Observatory of St. Petersburgh, the value was found to be $-76°$ C. The reading $-63{\cdot}2°$ C. corresponds with 82° of frost on the scale of the thermometer we use in England, $-68°$ C. with 90°, and $-76°$ C. with nearly 105° of frost.

The Colours of Flowers.—The distinguished German botanist, Professor Sachs, has discovered that the ultra violet and invisible rays of the solar spectrum are especially efficacious in the development of flowers. If these rays are suppressed, the vegetative organs grow luxuriously, but the flowers are almost entirely suppressed. The professor thinks that extremely small quantities of one or more substances, formed in the leaves, cause the formative materials which are conveyed to the growing points to take the form of flowers. They act like ferments, so that extremely small quantities of the flower substances act upon large quantities of plastic substances. Assuming there are three distinct regions of the solar spectrum, he shows that these differ in their physiological action. The yellow and adjacent rays cause the decomposition of carbonic acid, and are active in assimilation; the blue and visible violet rays are the causes of the movements of irritation; whilst the ultra-violet rays are those which produce in the green leaves the substances out of which flowers are developed.

The Levant Sponge Fisheries.—Sponge fishing extends all along the coast of Batroon, Tripoli, Latakia, and the Island of Ruad, north of Tripoli. It is not confined to native fishermen, for many Greeks go from Kalimno, Stanchio, Rhodes, and Samos, in their little craft, to share the trade with the Syrians. The fishing boats are generally from 18ft. to 20ft. long, and have a crew of four or five. The season commences in June and extends to October, this season being the most suitable, owing to the calmness of the sea. The boats remain out from sunrise to sunset; the divers are mostly young and middle-aged men, who remain at the bottom from sixty to eighty seconds at a time. They carry an open net, and use no instruments in collecting sponges. Accidents do not often take place during sponge-fishing. The divers descend to a depth of from 25 feet to 175 feet; below those depths no good sponges are said to be found. Three kinds of sponges are known in Beyrout—prime, seconds, and the red sponges taken near Batroon. The latter are by far the best. They have to be cleaned, freed from sand, and then pressed. The best qualities are exported from Beyrout to Paris direct, the others go almost exclusively to Trieste, while the Greeks send their catch to different markets in Europe.

WILL MEN EVER FLY?—II.

(*Continued from p.* 53.)

PASSING over many minor details, which lack of space will not permit us to particularize, let us see how same requirements are met in the case of the bird.

Again the strength of the skeleton and the muscular system is concentrated into the fore parts of the body, as the illustration (Fig. 2) we give of the skeleton of an eagle plainly shows. Not only are the bones themselves stout and strong, but the thoracic vertebræ are firmly consolidated together, while splints of bone, so to speak, spring from the transverse processes and overlap one another, thus greatly adding to the rigidity of that portion of the spine upon which the strain of flight is thrown. The shoulder-blade is completely changed in character, and assumes the form of a long, narrow bone lying parallel with the spine along the dorsal region of the thorax. The collar-bone is strikingly and curiously modified, first into the coracoid, or "neck" bones, which, sustaining the wing at one extremity, and at the other being firmly attached to the breast-bone, form the principal support of the shoulder, and, secondly, into the "merry-thought," which adds very greatly to the strength of this part of the frame.

The breast-bone, like that of the bat, is deeply keeled, but in a far more striking degree; and this is rendered necessary by the enormous size of the pectoral, or wing-muscles. These form the whole of what we generally term the "breast" of the bird, and most of us know to what dimensions they attain even in domestic poultry, whose powers of flight are not of the most striking description. And in such birds as the hawks, the swallows, and the gulls they are far larger and more prominent.

FIG. 2. SKELETON OF EAGLE.

The uses of the tail, as a rudder, need not be enlarged upon; no one who has ever watched the evolutions of martins and swallows can fail to have noticed how very important are its functions. And it is equally needless to point out that man possesses no tail.

The lungs of the bird, again like those of the bat, are

exceedingly capacious, while a still further provision for air is found in the form of a number of sacs, which occupy the whole remaining cavity of the chest. These, being constantly filled with heated air, naturally assist very greatly in diminishing the weight, while the principal bones, which are hollow, communicate directly with them, and are filled with the same unsubstantial medium. This latter fact has more than once been demonstrated in a somewhat singular manner, a wounded bird, falling into the water after sustaining a compound fracture of the limb, having respired through the projecting bone while its nostrils were submerged.

Upon the marvellous structure of the feathers, which add so greatly to the expanse of the wings and tail, while increasing the weight in only an infinitesimal degree, we need not enlarge, as they are not in themselves necessary to flight. But we may mention the fact that in a bird so comparatively weak in flight as the common sparrow, the area of the extended wings amounts to rather more than twelve square inches; and the sparrow weighs, when fully adult, only one ounce. Now, working out the calculation by rule-of-three, we find that a twelve-stone man, at the same ratio, would require a wing-area of no less than two hundred and twenty-four square feet; in other words, each wing must be twenty feet in length by about five and a half in breadth. And the strength of muscle necessary to work such wings may be imagined, but could scarcely be attained.

Finally, again, the position of a bird's body during flight is parallel with the plane of the earth's surface.

In the insects, in which we find flight in its utmost perfection, the bodily structure is still more strangely modified. But these we must consider in a subsequent paper.

(*To be continued.*)

HOW TO WORK WITH THE MICROSCOPE.

OUR modest hints, intended for absolute beginners, will not enter into any kind of rivalry with the large and elaborate books on the subject, from one of which (Dr. Beale's) we borrow our title. We speak to those who have just bought, or are just about to buy, one of the cheap and excellent instruments now to be had, and we wish to lead them a step or two along the right road.

It is not uncommon for the purchaser to bring away with him half a dozen ready-mounted slides, such as the proboscis of an insect, a micro-photograph of St. Paul's, and the like. There is no objection to this way of showing what the instrument can do, and bought slides satisfy that boyish curiosity which is usually a powerful though unconfessed motive with everyone who buys a microscope simply of his own pleasure. But the first step towards work has still to be taken. What shall it be?

We advise the beginner to procure the very simple appliances named in the following instructions, and to proceed as follows :—

Take a lock of wool, cleanse it from grease by thorough shaking in a small bottle with methylated ether, and cut off about a dozen hairs to a length of a quarter of an inch. Wet these with water in a small water-colour saucer. Pick them out with a small brush and a mounted needle, and arrange them in the centre of a clean glass slip. A drop of water will be taken out with the hairs, and this need not be removed. Now take a clean glass-cover, incline it over the hairs by resting one edge on the slip and supporting the other with a mounted needle. Gently lower it into its place, and the preparation is ready for examination. Repeat the operation several times, till all serious mistakes are avoided. The commonest mistakes are these :—1. Too much water is added to the hairs, so that the cover slips about. 2. Too little water is added, and the space is not filled. 3. Air-bubbles cling to the hairs; imperfect cleansing may be the cause. It is easy to avoid bubbles if the hairs are wetted with alcohol before mounting.

When wool can be rapidly and successfully mounted in water, go on to examine a leaf. A hyacinth leaf is good for practice, but any similar leaf will do. With a razor or perfectly sharp penknife, notch the surface of the leaf, take the cut edge between the blade and the thumb, and strip off a bit of the thin, transparent epidermis or outer layer of the leaf. The success of the operation may be judged by the absence of green colour from the epidermis. When a fair strip is got (it need not be large) place it in a little saucer of water, trim it with scissors, transfer to a slip by a brush well wetted with water, and mount as before.

Next, buy a shilling razor, which must be kept perfectly sharp, and try to cut sections through the hyacinth leaf. Hold the leaf vertically between finger and thumb, and cut from left to right, holding the razor quite horizontally. The blade must be kept wet with alcohol, poured on in small quantity from time to time. Draw the blade from side to side, so as to use nearly the whole length in cutting a single section. If you try to cut straight across, as bread is cut with a knife, you will crush the delicate tissues. When a fair section is got, float it off with alcohol or water, applied with a brush, and proceed as before. Remember that the section need not be large, but that it must be really thin; if it thins out to an edge, so much the better. Cut plenty at a time, without being too solicitous about every one, and then pick out the thin ones.

Six or seven evenings ought to bring a novice, not by nature clumsy or untidy, to this point. He is now ready to examine for himself a great variety of vegetable structures, or to study with advantage the fuller explanations of practical books. But let him aim at simplicity in everything. Having learnt to mount in water, or glycerine and water, let him learn to mount in balsam, and stick to these two methods till he has got some real skill. When the time comes to use stains, take one stain, say borax carmine, and try no other for a long time. The common mistake is to have so many resources that nothing ever succeeds as it should.

Lastly, do not be too solicitous about preserving your early attempts. They have no real value, and, if you get on as you ought to do, you will laugh at them very soon. The working microscopist in biology, for example, selects very rigorously, and only preserves what is rare or unusually good. He is not thinking perpetually about his cabinet, but about his studies—a very different thing! Aim not at a well-stocked cabinet, but at the power of demonstrating, whenever required, all the details of a new plant or animal.

THE SUN'S PARALLAX.—The horizontal parallax of the sun at its mean distance from the earth is now determined at 8″, 808.

Natural History.

THE HORNED LIZARD.

The Natural History Museum of Paris possesses in its collections a curious reptile from St. Domingo. It was first identified by Lacépède, and Wagler has referred it to the genus Metapoceros.

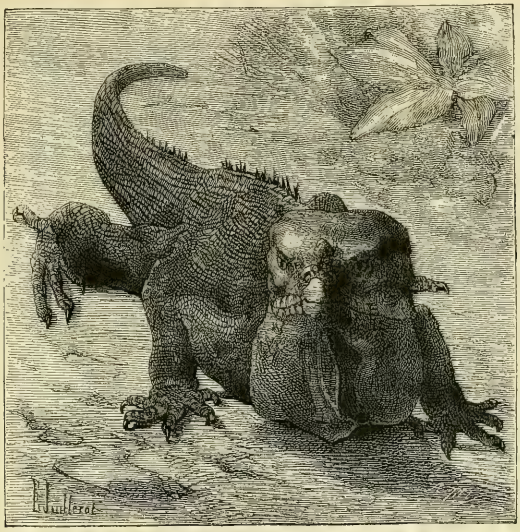
It is a saurian of the Iguana family, and is distinguished from the true Iguanas by its teeth, which are similar to those of the Cyclures, and by two rows of hairs below the thigh. The only species known is the *Metapoceros cornua*, remarkable for having on its forehead a tubercle in the shape of a horn.

This lizard recalls, in its form, the huge fossil Dinosaurians known as Iguanodons, the bones of which have been found in the cretaceous and Wealden deposits, some having been discovered very lately at Bernissart, in Belgium. The lizard now in Paris is shown in the accompanying engraving, taken from a recent number of *La Nature*. It measures about 28½ inches in length, and its body is heavy and squat, of a blackish brown colour. The dorsal line is furnished with spines, gently curving back, extending from the back of the head to the commencement of the tail, where there is a small space without them; they reappear, however, on a certain length of the tail. The tail is not cylindrical, as in the European lizards. It is compressed laterally and provided with powerful muscles, which enable the creature to wag it suddenly and violently from side to side to defend itself if it be attacked. The feet are strong, and turned outwards from the body.

The head offers very strange peculiarities; behind on the back is a kind of hump, in front is a horn, and the sides are broad and arched. Below the lower jaw is a fold of skin flanked on each side by hanging cheeks or pouches, which impart, to a front view, a curious aspect, as may be seen in our illustration.

The collection possesses a few examples of this saurian, but this is the first time a living individual has arrived at the menagerie, consequently their habits are unknown. However, since its arrival, its slow walk and some vertical movements of the head have been noticed. If approached, it seems to put on a ferocious appearance. It is fed on leaves of lettuce and a little meat, but has not much appetite. This animal is closely related to the Cyclures, the Anolians, and the Amblyrhynchi. The latter were studied by Darwin in the Galapagos archipelago. It is probable that their habits approach those of the Metapoceros. There are two species, one aquatic (*Amblyrhynchus cristatus*), the other terrestrial (*Amblyrhynchus demarlii*. In speaking of the latter species, Darwin says "these animals eat during the day, and do not go far from their holes; if they are frightened they run in a very comical fashion. They cannot run very fast, except when they descend sloping ground; this evidently depends upon the lateral position of their feet. They are not timid; when they watch anything attentively they turn up their tails, and raising themselves on their forepaws, continually bob their heads up and down, at the same time assuming a fierce aspect. They are not, however, ferocious; if their feet be touched, they instantly lower their tails and escape as quickly as they can." Darwin has noticed that the small lizards which live upon flies, move their heads in exactly the same manner when they examine anything.

This species digs its holes on the surface of the ground, and in walking in a district inhabited by these lizards, one frequently breaks into them. They dig with the



The Horned Lizard.

feet on one side of the body only; when these are fatigued the feet on the other side carry on the work.

The Intelligence and Development of the Oyster.—The following facts on this subject appear from the writings of Professors L. Morgan, Frank Buckland, and Rev. W. Bingley. The oyster does not possess special organs of sight, but the fringe of the mantle, its organ of touch, is vaguely sensitive to light. It has no auditory organs, but it appears to have some sense analogous to smell or taste by which it can test the incoming water. Mr. Bingley thinks that oysters are able to derive some knowledge from experience. If removed from spots constantly covered with water they open their shells, lose their water, and die. But if laid down in places from which the sea occasionally retires they learn to keep their shells close until the tide returns. They may be gradually trained to a longer and longer exposure to the air without gaping—a fact which is turned to practical account in the "oyster-schools" of France. During the summer, when the oysters are out of season, the development of the spawn, or "spat," as it is technically called, takes place. The number of eggs in an oyster in this condition ranges from 276,000 to 329,000. At last the mother-oyster opens her shell, and the young issue forth like a puff of smoke. Each young oyster at birth is provided with swimming organs in the shape of delicate ciliae, and by their means begins to play about the moment it leaves the maternal shell. This swimming apparatus is lost as the oyster arrives at maturity, and the creature thus loses the power of locomotion, and becomes comparatively a fixture. The valves of the young oyster's shell are smooth and transparent, symmetrical and united by a straight hinge. The mouth is large and lies opposite the hinge, so there are no gills. Between the valves there projects an oval cushion supporting the swimming hairs by which the young mollusk propels itself through the water. At pleasure the cushion may be drawn back into the shell, when the oyster sinks. It need scarcely be said that only a small part of the cloud of young oysters escape the attacks of their numerous enemies and survive to maturity.

Gibraltar.—We find in the *Entomologists' Magazine* a paper by Mr. James J. Walker, an officer of Her Majesty's gunboat Grappler, on "A Year's Insect-Hunting at Gibraltar." The insects that swarm about the rock are of wonderful interest. There is scarcely a day throughout the year on which butterflies may not be found, and Mr. Walker enumerates fifty-five species for the limited district, thirty of which have occurred on the rock itself. He has found 900 species of beetles, and is daily adding to the number. Apart from the purely entomological interest of the paper, the introductory portion is of great value, being a lucid *résumé* in a few pages of the topography of the rock and the immediate neighbourhood, with sketches of the chief botanical, zoological, geological, and meteorological features. As is well known, the rock is the sole European locality in which the Barbary ape is found in a wild state. These animals, reduced a few years ago to less than a dozen individuals, have of late greatly increased in numbers, and, being strictly protected, are very bold and fearless. The fig trees in the gardens suffer so much from their depredations when the fruit is ripening that it is found necessary to employ men to scare them away. The Barbary partridge, though numerous on the rock as well as on the opposite African coast, is, like the monkey, found nowhere else on the European Continent.

Edible Birds' Nests.—Large quantities of edible birds'-nests are brought from the mammoth Gomanton caves, which are situated about twelve miles to the northward of Malapi, on the river Kinabatangan. The nests collected are valued at 25,000 dollars per annum, and the North Borneo Government in 1884 let the caves at a yearly rental of 9,000 dollars. The height of one of the vaults in these limestone caves is estimated at 900 feet, upwards of twice the height of St. Paul's, London; and some idea of the swarms of swallows (*callocalia*) may be gathered from the statement that a steady column of these birds has been timed by the watch to fly for three-quarters of an hour from one of the apertures. All these birds'-nests are sent to China, where they are prized as a luxury in the well-known Chinese birds'-nest soup.

Introduction of Goats into New Guinea.—It is painful to find that a number of misguided persons are turning goats loose in New Guinea. As there are there no carnivorous animals to keep these tree-destroyers in check; the result may be the ruin of the magnificent flora of that island, and ultimately of its fauna also.

The Reproduction of Alcyonidium Gelatinosum.—Dr. Hincks, in his *British Marine Polyzoa*, pronounces the individual polypides of this species unisexual. Mr. W. A. Herdman, on the other hand, holds that *Alcyonidium gelatinosum* is probably a hermaphrodite in which the reproductive systems arrive at maturity at different times in their life history.

The Habits of the Hessian Fly.—Prof. Lindeman has communicated to the *Bulletin de la Société des Naturalistes de Moscou*, two elaborate memoirs on the Hessian fly. He concludes there is no universal remedy for this scourge, because the manner of life of the insect and the conditions of its propagation vary in different countries. Three generations appear yearly near Moscow, one in spring, one in summer, and one in autumn. Each of these must find for its support green stems of grain capable of remaining succulent during the twenty-eight days in which the insect remains in the larval condition. Among its insect enemies he notices a *Geophilus* (Creophilus), the larva of a *Cantharis*, and a mite.

The Kingfisher.—L. F. S., in a communication to *Land and Water*, speaks of a tame kingfisher which he found in a cottage on the banks of the Wye, near Hereford. On its owner pouring some water and a few minnows into an earthen pan the bird came, and perching on the rim of the pan soon captured all the fish, first killing each one and then swallowing them whole. The writer does not believe that the kingfisher catches his booty in deep water. Another writer in the same paper, S. B. Coates, found a kingfisher choking in an effort to swallow a perch about 2½ in. long. The fish was extracted, but the bird survived only for twenty-four hours.

Weasels and Frogs.—That the weasel (*Mustela vulgaris*) destroys frogs is proved by the following inci-

dent. While standing near a pond on his estate, a gentleman at Worcester observed a weasel give chase to a frog, which it followed to the water and succeeded in capturing. Holding it firmly by the head, the weasel emerged from the water and brought its victim to the bank, but on finding itself disturbed let go the frog and disappeared. Happening to visit the spot on the succeeding day, the gentleman found the frog alive in exactly the same place where it had been left by the weasel, although it had been bitten through to the skull.—*Nature.*

Luminous Bacteria.—Three new kinds of luminous bacteria have been described by Dr. Katz, in a communication to the Linnean Society of New South Wales: *Bacillus Argenteo-phosphorescens*, I., II., and III. All three give off a fine silvery light. No. I. liquefies gelatine, which II. and III. do not.

Memory of Wasps.—From some experiments made by G. W. and E. G. Peckham, and described in the *American Naturalist*, it would seem that wasps remember the locality of their nests for ninety-six hours.

Physiological Selection.—Professor G. J. Romanes, writing in *Nature*, does not see how Mr. Seebohm can reconcile his doctrine of a pre-ordained or teleological variation with his theory of the paramount influence of geographical isolation. Mr. Wallace, having argued in favour of collective variation, *i.e.*, of a considerable percentage of identical and beneficial variation arising simultaneously in the same community, Mr. Seebohm replies that by the admission of this fact Mr. Wallace has dethroned his own theory of natural selection from its position as the main factor in the origin of species.

The Leaps of Hares.—Mr. R. W. Shufeldt communicates to *Nature* a notice of the leaps which the Mexican hare (*Lepus calliotis calliotis*) and the sage hare (*Lepus sylvaticus Nuttalli*) make when put to their utmost speed. The former makes bounds of twelve to thirteen feet, and the latter of six to seven feet. The distances were measured in a thin layer of newly-fallen snow. It is to be noticed that Mr. Shufeldt uses the trinomial nomenclature now common among American zoologists.

THE GREEN COLOURING MATTER OF PLANTS.

IN a former number we noticed some of the points of interest presented by the red colouring matter of animals. What the red colouring matter is to the higher animals the green colouring matter is in many respects to the higher plants—equally prevalent or even more so, equally necessary to the functional activity of the organism, and hardly less complex in its chemical and physiological relations. The function of the two substances is not however identical. Hæmoglobin is solely of respiratory value, the green colouring matter of plants is entirely nutritive in function.

The green colour found in nearly all flowering plants and very many others depends upon the presence of a substance called Chlorophyll, which may be readily extracted by certain solvents, such as alcohol or benzine. Water does not dissolve chlorophyll, but boiling in water renders the action of alcohol the more rapid, by freeing the chlorophyll from the particles with which it is intimately associated. A solution of chlorophyll is tinged with the same green colour as the leaves. When examined by the spectroscope, light which has traversed a chlorophyll solution is found to have undergone change. Certain kinds of rays in the violet and blue parts of the spectrum are filtered out, and there is also a dark band between the lines B and C, which indicates an important absorption of the red rays. Another optical characteristic of a chlorophyll solution is its dichroism. When examined by transmitted light it is of a beautiful green, but examined by light falling upon it and with a black background, it has a claret colour, perhaps due to the reflection of rays which have been absorbed and whose rate of vibration has undergone change.

The percentage composition, though not the chemical constitution of chlorophyll, is known. It consists of the four elements (carbon, hydrogen, oxygen, and nitrogen), of which plants are almost entirely composed. Iron is not believed to enter into the composition of chlorophyll, but it is apparently as necessary to the green colour of chlorophyll, as to the physiological activity of hæmoglobin. If a seedling be raised in an artificial soil from which all compounds of iron have been scrupulously excluded, it has a blanched appearance, but if a solution of some salt of iron be then painted over one of the leaves, the green tint quickly appears wherever the brush has passed.

In the living plant chlorophyll is rapidly used up and regenerated. This is shown by the blanching of a green plant kept in the dark for a few days, and by the speedy restoration of the green colour when light is readmitted. The blanched plant is not quite colourless, but yellow; it contains a yellow substance, Etiolin, which is nearly allied to chlorophyll and possesses in some degree the same physiological properties. Other colouring matters are common in leaves and flowers. There is, for example, a red colouring matter (Erythrophyll), which is soluble in water, and a yellow colouring matter (Xanthophyll), very similar to chlorophyll, with which it is mixed in most green leaves. Xanthophyll occurs nearly pure in bright yellow flowers.

The practical importance of chlorophyll lies in its power of decomposing carbonic acid. The gas is absorbed by leaves, and wherever it comes in contact with chlorophyll it is broken up, provided that the leaves are illuminated with bright sunlight, or at least daylight. The carbon is appropriated by the plant, and goes to form starch and other useful substances, while the oxygen is exhaled. This was proved so long ago as 1772 by Priestley, who showed that plants of mint, spinach, and balm rendered air which had become foul by respiration again fit for breathing and capable of supporting a flame. We now know that plants produce in sunlight a gas capable of being identified with oxygen, that the formation of oxygen by plants does not take place except in sunlight, or some light of similar character, that an increased supply of carbonic acid increases the yield of oxygen, and that the absorption of carbonic acid produces an increase of weight in the plant. By a modern microscope it is easy to see the starch-granules newly formed within chlorophyll bodies exposed for a few hours to light, and which previously contained none.

An impressive experiment, which may be made by anybody, illustrates the formation of starch within a green leaf. Take a broad leaf, *e.g.*, of primrose, blanch

it by boiling in water and subsequent soaking in alcohol. Then place it in a dilute solution of iodine (tincture of iodine and water), of a light brown colour. If the leaf has just been exposed to light for some hours it will turn purple in consequence of the presence of abundant starch; if not, it will remain unchanged. The experiment is best made in the evening of a sunshiny day. One leaf may be taken from a plant which has been exposed to full light, another from a plant which has been completely shaded by a flower-pot inverted over it.

The precise way in which sunlight effects the decomposition of carbonic acid in the presence of chlorophyll has been carefully investigated, and during the last year or two, facts have been brought to light which materially affect current views.

It was once supposed that chlorophyll was capable of direct conversion into starch, and that as it became used up in this way, more was formed. There is, however, no direct proof that chlorophyll is capable of such conversion, and there is no reason to believe that the chlorophyll in a green leaf diminishes in proportion to the formation of starch.

Some years ago Pringsheim was led, mainly by the study of the spectrum of chlorophyll, and of the action of variously-coloured light upon plants, to suggest a new explanation. He taught that a solution of chlorophyll allows such rays to pass as promote the decomposition of carbonic acid, but stops such as promote the reverse action, viz., oxidation of the carbon. His experiments tended to prove that the decomposing rays were the yellow and green rays, which pass almost unaltered through chlorophyll, and that the oxidising rays are the blue, violet, and ultra-violet rays, which are quenched by chlorophyll. The chlorophyll, according to Pringsheim, acts not as a direct reducing substance, but as a screen, keeping off the rays which undo the work of reduction. There was from the first one startling difficulty in the path of this screen-theory. It supposed, contrary to all analogy, that the absorbed rays were actually injurious to the tissues, while the rays which pass almost unabsorbed do the work of assimilation.

It has been found possible by improved methods to determine more exactly the effect of different rays of the spectrum upon green plants. The older observers, using a slit to separate light of a particular degree of refrangibility, were in this dilemma, that if they used a very narrow slit, they got a light of no effective intensity, while if they widened the slit they got an impure light, in which different kinds were mixed. Timiriazeff has at length got over this difficulty, by using a pure light of known refrangibility, and very delicate means of estimating its effect. He exposes a green leaf to such light, and soon gets a tiny bubble of gas. This he collects in a dainty syringe, formed out of a thermometer-tube, and uses the tube not only to collect but to measure the gas. The bubble is then expelled from the syringe, and made to pass through pyrogallic acid, after which it is returned to the syringe and remeasured. The difference between the first and the second measurement gives the amount of oxygen present in the bubble, the rest of the gas being nitrogen. A very short exposure being required, the same leaf may be exposed many times under the same conditions to light of different colours and qualities.

Timiriazeff's experiments bring out the very interesting result that the decomposition of carbonic acid is chiefly effected, not by yellow or yellow-green light, as was till lately supposed, but by red light, and that the maximum effect corresponds with the conspicuous absorption-band seen between B and C in the chlorophyll-spectrum.

Timiriazeff has endeavoured to penetrate yet further into the mysterious action of chlorophyll. The photochemical researches of Vogel, Becquerel, and Abney have revealed the existence of substances, among which chlorophyll is to be reckoned, which may be called *sensitizers*. They absorb rays of light and transfer the vibrations of their own molecules to another substance less easily affected by light, whose decomposition is thus effected. For instance, an ordinary photographic plate, when exposed to the solar spectrum, does not record the the red rays at all; iodide of silver is not sensitive to red rays. But if the collodion is tinctured with chlorophyll, the red rays affect the plate, and the chlorophyll absorption-band becomes visible. The sensitizer must be capable of decomposition, by the rays which it absorbs, for it is only while undergoing decomposition that it can set up decomposition in another substance. Now chlorophyll is known to undergo such decomposition and the chlorophyll-spectrum can be printed on paper stained with chlorophyll. The rays which decompose chlorophyll are the same rays which decompose carbonic acid most powerfully.

The red rays of the spectrum are therefore capable of doing chemical work, and in particular of decomposing carbonic acid. Their special fitness for this work depends partly upon their energy, and partly upon the amplitude of their vibrations. Abney and Langley have shown that the maximum of solar energy is attained at a point in the spectrum between B and C, which precisely corresponds with the absorption-band of chlorophyll. What chlorophyll does is evidently to transform into chemical work the rays which possess the greatest energy.

It is the red rays which possess the greatest amplitude of vibration, and Timiriazeff compares them to the high waves which cause a skiff to founder. It is just in that part of the spectrum where the waves run highest that the molecule of carbonic acid undergoes dissociation.

WANT OF A SANITARY SYSTEM IN RUSSIA.

THE Vice-Director of the Russian Medical Department, Dr. Bubnoff, has recently issued a report on Sanitation in Russia, in which he remarks that no working sanitary system can be said to exist in the empire. This is, indeed, only too true, as all the reports which pass into the archives of the Medical Department must impress on the minds of those who, like Dr. Bubnoff, are responsible for the sanitary condition of Russia. The death-rate in some districts ranges from 60 to 80 per 1,000, of which an enormous proportion is due to mortality amongst children—in some places, indeed, as much as 79 per cent. of the total mortality. In spite of a high birth-rate, the population is increasing only at the rate of 1 per cent. Every year some 2,800,000 persons die in Russia. According to Dr. Bubnoff's statistics, something like 1,000,000 of these deaths may fairly be traced to preventable causes. There is a great paucity of medical men, of whom there are only about 5,000 altogether for 100,000,000 inhabitants, and these of course tend to congregate in the towns, so that in the rural districts doctors are to be met with only at long intervals.

Reviews.

First Year of Scientific Knowledge. By Paul Bert. Translated by Mme. Paul Bert. Fifth Edition. London: Relfe Brothers, 1887.

This excellent little book differs essentially from most of its kind, as far as we know them, in being scientific in spirit. The temptation to make a book attractive to young readers leads often to its becoming a collection of striking curiosities, used to catch the imagination only, and not to lead up to and illustrate scientific principles. Such a book does not teach science, does not educate the mind scientifically; interesting facts about habits of animals, or chemical and physical experiments, have a charm for many minds, but no more form a training in science than a collection of postage-stamps forms a training in geography. In the book before us all the charm exists, and we see in addition to it a thread of purpose linking the facts together; the child, and, indeed, the man and woman wise enough to read, may be helped to think out connecting principles and to draw reasonable conclusions, so that the final outcome should be not a mind merely stored with bits of knowledge about animals and plants and stones and gases, but one trained to appreciate the value of accurate reasoning about such things, one wherein is laid a firm foundation for sound work in the future. We heartily commend this valuable part of the work of the late M. Bert to all who would further the best education of children. It is worthy of notice that over 300,000 copies of the original were sold in three years, and that it is used in nearly every school in France. The illustrations are many, and are very well suited for the purpose of directing the attention of children to salient points, a matter too often sacrificed to a love of pretty pictures.

Elektrische Apparate, Maschinen und Einrichtungen. Eine Sammlung von Beschreibungen zum Gebrauch für Techniker, Ingenieure, etc. W. E. Fein. (J. Hoffmann, Stuttgart, 1888).

This finely illustrated and well got-up book, although appearing at first sight to be a manufacturer's catalogue, contains neither prices or advertisement. The arrangement is rather confusing, but we find in the preface that it is a chronological description of the author's work since 1867. The book would be more useful to the "techniker" (an expressive, hardly translatable word, meaning one who is technical) if the apparatus had been grouped under a few heads. It leads off with a Wilde dynamo with two Siemens armatures; this is followed by an ordinary electric bell indicator, thermometer alarms, bells, batteries, etc. An "Alarmvorrichtung für Leichenhallen" is a gruesome device for use in a mortuary, and might be connected with startling effect to the "Rücksignal," or repeating bell push, which announces "Man kommt!" An indicator for showing the height of water bears a good deal of resemblance to one which was described by Mr. Upton at the last meeting of the British Association at Manchester.

Many forms of telephone are illustrated and described, and diagrams of the connections are given separately. The author is best known in this country as the inventor of a dynamo, with extensions of the magnets on the inside of a Gramme armature. The first machine of this kind is dated 1880. The principle is based on the much-debated notion that the inner wires are useless. This feature is abandoned in the later machines. An account is given of a series of experiments with dynamos of different shapes, to determine the best form of field magnet. The results have been published in *Industries*. The pattern which the author considers best offers difficulties of manufacture which will deter most dynamo builders from following him. An alphabetical and a classified index diminishes, to some extent, the drawback of the chronological arrangement.

Bird-Stories, Old and New, told in Pictures and Prose. By Harrison Weir. London: Society for Promoting Christian Knowledge.

The "pictures," as might be expected from the artist, are admirably bird-like in expression and attitude. The "prose," though brief and simple, contains not a few valuable observations. For instance, the fact of rooks coming back every spring to visit the site of their former abode, though the trees had been cut down more than twenty years ago, is a good proof both of the longevity of these birds and of their tenacious memories. Still more curious that a young cuckoo is fed, not only by its foster-parents, but by other birds which happen to be in the neighbourhood. The design of a cat put to the rout by a pair of great tits, whose nest she has been attempting to rob, is, in its way, delicious. We could wish that every cat might fare thus when on bird-nesting expeditions, always except in the case of the common sparrow. The anecdote of an old cock parting two young cockerels who wished to get up a fight, is very interesting.

The common magpie is justly described as an inveterate robber of chicks and ducklings. But their impudence and rapacity in Norway are far more marked than in England. In spite of the combined vigilance of men and dogs they often succeed in carrying off the larger portion of a brood.

The account of the "drover raven," whose delight it was to turn sheep out of the right road, is most amusing. There is in many birds a vein of mischief. We once saw a small party of sheep which had evidently come astray, soberly travelling along a main road, when suddenly a flock of geese rushed out of a farm-yard, and with loud cries and flapping of wings chased the terrified sheep for about a quarter of a mile into a by-lane.

The pea-shelling habits of the jay are duly recorded. Beautiful as these birds are it is not pleasant to take up pod after pod of peas, and find that they have been emptied so skilfully as to look untouched.

Mr. Harrison Weir utters a timely protest against the barbarous folly of destroying owls to make ornamental screens of their wings. We want some good, sharp legislation on the subject of using for personal or household decoration birds which cannot be multiplied at pleasure. But here, as in many other good movements, we must count on the most determined opposition of the economists.

"Bird-stories" will afford pleasant and not unprofitable reading to the old as well as to the young.

The Student's Handbook of Chemistry, with tables and chemical calculations. By H. Leicester Greville, F.I.C., etc. Edinburgh: E. and S. Livingstone.

Although there are so many treatises on chemistry we welcome the appearance of the second edition of this clear and concise manual. It is not as bulky as the first edition, but owing to the use of a smaller type it contains no little fresh matter.

The first four chapters deal with chemical philosophy;

the non-metallic elements are then described; and next follows a chapter upon the higher principles of chemical philosophy. Here the author draws attention to Berthollet's and Richter's laws, points out the influence of mass in chemical change, explains specific and atomic heat, indicates the method of calculating heats of combustion, and describes the periodic law, but does not refer to modern thermal chemistry.

After a description of the metals and their compounds, analytical tables are given. Scattered through the first portion of the work are numerous tables, comparing together the properties of the different groups of elements and showing the action of heat upon their compounds. These tables form a valuable feature of the book.

In the first chapter of the second part there is a curious mistake; the figure to which the reader is referred in the description of the method for estimating carbon and hydrogen in organic substances being the figure for the determination of nitrogen by the soda-lime process described a little further on. In the determination of vapour densities, we do not notice a description of Victor Meyer's process now much used; otherwise this section seems well written, although the isomerism of the benzine ring deserves a little more notice.

The book ends with a useful chapter on animal and vegetable chemistry and with a glossary of chemical terms.

The treatise seems remarkably free from mistakes; we having only noted two slight printer's errors. We can strongly recommend its use as a text-book.

Studies in Philosophy. By the Rev. J. Lightfoot. Edinburgh and London: Blackwood and Sons, 1888.

Mr. Lightfoot dances well in his fetters; he has produced a little book on a big subject, which would be a very nice little book indeed were it not that the big subject demands a great deal of room and fresh air and freedom, and that Mr. Lightfoot wrote his little book without any one of them. Nevertheless it is almost a nice little book, and is quite worth reading by the many people who want to begin to know something about Realism and Idealism, Monism and Dualism; and who are not content to refute Berkeley, as Dr. Johnson did, by kicking a stone. As an effectual warning to those who have passed the initial stage of philosophic inquiry, we quote Mr. Lightfoot's last few words:—"Come with me into the laboratory," says the scientist to the philosopher, "and I will show you once and for all the solution of the great question. You see this bag with hydrogen and that with oxygen. Here, you see, we mix the two; here also is the spark; you hear the 'pop'; now you see the water. Having seen that, now look on this other table," he says, "and I'll show you how life is produced. Here, you see, I have some water, ammonia, carbonic acid. And whilst you gaze with hushed breath, expecting the revelation of the mighty secret, looking curiously for the electric spark which is to turn these into living organism (*sic*), you merely hear him tell you that, by FEEDING PROTOPLASM WHICH IS ALREADY ALIVE with these, IT will by-and-by *turn out a fresh supply of life*. Alas, for your expectations! you come away sadly. The explanation of life *is life*. The scientist, you will say, can conjure very cleverly when he has got the whole universe to conjure with." N.B.—The emphasising type is Mr. Lightfoot's own, but he says that the lecture from which we quote "is largely based upon Dr. H. Stirling's book 'Concerning Protoplasm,'" a book supposed by Mr. Lightfoot to be a "crushing criticism of Professor Huxley's theory" of the basis of life, and also "of that school of philosophy generally with which the Professor is identified." Poor Professor Huxley! With Dr. Stirling, and Mr. Lightfoot, and his Grace of Argyll, he should indeed be having a hard time of it; but then he is a bold, bad man, and perhaps he does not feel such castigations as he ought.

The Autobiography of an Acorn, and other Stories. By James Crowther. London: Sunday School Union.

This work is scarcely what might have been expected from its title. The acorn in question, though produced in the midst of a fine old forest, and springing up as a young tree, does not become a giant patriarch, and tell us its centuries of experience. It is prematurely cut down at the untimely age of forty, and hewn into walking-sticks, one of which narrates the remainder of the story. Now, we can very well conceive of a living plant as endowed with a dim consciousness, but when after its death this consciousness is supposed to survive in one of its fragments, transformed into an oaken cudgel we feel an unpleasant shock.

This, however, would soon be overlooked if the book were to a greater extent free from inaccuracies. Unfortunately, it is rich in errors of various kinds, which, with a little care, might have been avoided. Thus we read that gold is the softest and heaviest of all the metals. Such is by no means the case; potassium, sodium, gallium, and lead are softer than gold, and platinum is very decidedly heavier. Nor can we accept without evidence the statement that "at a distance of twenty-one miles below the earth's surface gold is found in a pure and liquid condition." In like manner we must demur to the assertion that "no stone but a diamond will write upon glass. A few pages further a diamond is reported as saying that "my native home is chiefly India, South America, Golconda, and Brazil." Any one who had not "passed" in geography, on reading this passage would suppose that we had here four distinct diamond-yielding countries, instead of learning that Golconda is and was the diamond region of India, and Brazil that of South America. Nor is there any reference to the great African diamond fields.

Mr. Crowther is again at fault in declaring that bees *always* leave their lives in the wounds which they inflict with their stings. Elsewhere Ceres is said to have been "the heathen goddess of flowers and fruit," functions which belonged respectively, in the Roman mythology, to Flora and Pomona, Ceres being merely the tutelary genius of corn. Chlorophyll is said to mean in Greek, "green flesh." It is generally known to signify "leaf-green," *i.e.*, the green colouring-matter of leaves. But we do not care to accumulate further instances of inaccuracies in detail, since we must refer with regret to the author's absolute views on instinct, and to his attempts to uphold the doctrine of individual, mechanical creation in opposition to the much loftier and worthier views of creation commonly known as Evolution. It is sad when a book intended for children, and in other respects calculated to be popular, is made to teach what in after life will have to be untaught. We notice with pleasure the author's protest against the slaughter of hummingbirds for the gratification of a barbarous vanity.

HONEY.—It has been calculated that to make 1 lb. of honey the bees must visit from 90,000 to 225,000 flowers.

THE USE OF FORESTS.

SOME time back the world was of opinion that trees were of value merely as supplies of timber, and that where building materials could be easily imported a country might, without any disadvantage, be laid entirely bare. To be sure, a few far-seeing individuals, such as Bernard Palissy, were aware of the influence of woodlands as regulators of climate. Similar views were taken in antiquity by Critias, who spoke vaguely of the "sickness of the country in consequence of deforestation," and in 1540 by Fernando Colon, who declared that the rains in Madeira, the Azores, and the Canaries had become rarer since the trees had been cut down.

But, in spite of these warnings, the process of "clearing" was carried on in most countries with reckless haste. This havoc was not arrested until its consequences were pointed out by Humboldt, Boussingault, and Becquerel, and by a still more authoritative teacher, experience, who on this occasion seems to have charged unusually high school-fees.

One of the most important effects of woods upon a climate is that they promote rain. The theory of this process is not perfectly understood, but the facts themselves are matters of experience. There are districts on the Continent where the chief rivers have decreased notably in volume, since the clearing of the districts about their sources. We have seen a small stream, a tributary of the Oder, which, within the memory of living persons, turned in its short course two or three corn mills. At the time of our visit it was dry all the summer months, save immediately after a thunderstorm.

In many districts of Southern France the destruction of the forests has caused much more striking mischief. The rain, instead of falling as heretofore in moderate showers, now comes in violent gushes, with long periods of drought between. As the natural consequence the grasses and other low-growing plants perish, their roots wither away, and the soil, no longer held together by their fibres, is washed away by the occasional violent rains and carried down into the beds of the rivers. The hill-sides and the higher plains remain as barren wastes of sand, gravel, and shingle.

A similar process has been going on in Spain, Italy, Greece, in Algeria, Morocco, and, in short, all around the Mediterranean. Countries which were once the granaries of the world, and which supported a numerous and thriving population, are now little better than deserts. Nor has this mischief been confined to Europe. The vegetable wealth of South Africa, when it first became known to Europeans, was remarkable. The "Cape" was the source of numbers of our finest greenhouse plants. But now vast tracts have been rendered so desolate that a troop of the Colonial cavalry on the march actually gave three cheers at the sight of a tree. Even in the United States, once regarded as eminently the land of forests, many regions have lost, first their vegetation, and then their soil, in consequence of tree-felling.

It may, perhaps, here be objected that, fully admitting all these unfavourable changes, they may possibly have been produced by unknown causes, and would have occurred all the same if the woodlands had not been interfered with. This plea can easily be refuted. In many of the countries above mentioned replanting has been undertaken on the large scale by individuals, by communities, and by Governments, and with the most decisive results. Wherever such attempts have been made the climate becomes less extreme, the rainfall more uniformly distributed, and public health is improved. Such beneficial changes have been distinctly recognised in North-Western India, where fertility is gradually returning to the deserts. In France, within about twenty years, 250,000 acres of mountain lands, and nearly the same extent of sandy coast lands, have been replanted—of course at great expense, but with the most satisfactory results.

In America, also, replanting is being vigorously carried on. An eminent agricultural authority in the United States has given it as his opinion that, if one-fourth of a country is left covered with trees, the remaining three-fourths will yield a better return in the shape of crops than would the whole if stripped bare.

It may, perhaps, here be urged that in England we have in most seasons decidedly more rain than our farmers and gardeners relish, or, at any rate, if not a greater annual depth of rain, yet a greater number of rainy days. But at the same time Britain and Ireland have been stripped of their forests to an extent scarcely equalled in any other part of the globe.

It must be remembered, however, that our geographical position is decidedly exceptional. Our western shores are washed by the Gulf Stream, and we thus have an atmosphere overladen with vapour. This moisture, on coming in contact with colder air-currents, is condensed and precipitated in the form of rain. Thus our experience forms no exception to the general truth, that in the absence of forests the rainfall becomes, if not scantier, at least more irregular and capricious.

But if deforestation has not rendered these islands subject to drought, it has done great injury to agriculture and horticulture by promoting the play of the winds. High and strong winds during the spring, summer, and autumn certainly rank among the chief enemies which the farmer and the gardener have to encounter. In early spring the blossoms and the "setting" fruits are dashed off the trees; a little later the fructification of corn is interfered with; in the summer the mowing-grass or the ripening grain are beaten down; and in September and October apples, pears, etc., are prematurely shaken from the branches. How well the nurseryman and market gardener are aware of the injurious effects of wind may be seen from the hedges with which they intersect their grounds at short intervals, not as fences, but simply as screens. It would have been well for this country if our moorlands had remained covered with trees, and if the cultivated parts of the country had been left intersected with belts of timber.

It must be remembered that, contrary to vulgar prejudice, the "clearing" of a country is apt to render it, not more, but less, salubrious. In epidemics—*e.g.*, in the cholera epidemic in Trinidad—it was found that, whilst the population in open plains was decimated, the inhabitants of houses well screened by trees almost invariably escaped. Man, in fact, is, by his origin, a woodland animal—a truth which, though couched in different language, is taught alike by Moses and by Darwin.

PETROLEUM OIL.—The Droojba Fountain at Baku sends up a column of oil 200 to 300 feet high 18 in. in diameter, and forces the oil out of the earth at the rate of 2,400,000 gallons every twenty-four hours. This is nearly equal to the output of all the 20,000 wells in the oil fields of the United States.

Abstracts of Papers, Lectures, etc.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

The inaugural address of the session was delivered by the newly-elected president, Mr. Edward Graves, of the Postal Telegraph Department, who stated that he desired to trace the nature of the benefits already conferred upon the world by the use of electricity in some of its varied expressions and to gauge the extent of the employment it had given by means of its operations to at least the inhabitants of our own country. It is almost impossible, he said, to express the variety of ways in which the action of electricity is utilised. Their name is legion, and they are ever multiplying. Communication between distant places was the first widely-extended purpose to which it was practically put. Originally its operations were confined to points separated by land only. Then intervening rivers, channels, seas, and oceans were successively crossed, until now nearly the whole earth is bound together by submerged chains. Another most prominent utilisation of electricity is for the purpose of illumination. First practically discovered by Humphrey Davy, its powers in this direction were sucessively made practical by Wylde and De Meritens, Pacinotti and Gramme, and by many eminent scientists of later date. Electric-lighting has passed very many stages. Differing from telegraphy, it needed a longer period of trial and experiment after its commercial application began; and it is, of course, exposed to the competition of other illuminants ever seeking, by new methods, to lessen its superiority. Economy of production is, perhaps, the great necessity for its complete development. Telephony has met with wide acceptance and has had a vigorous growth. In electro-metallurgy, electro-plating, electrotyping, and the like uses, electricity operates in many different directions. The substitution of electricity for steam, water, or gas as a source of power capable of driving mechanical engines, and the transmission of similar power to a distance from its source of origin, may be considered as still in the earlier stages of experiment and growth. There is a wide field yet to be explored in this direction. For medical purposes electricity is also extensively employed. Electricity is also utilised to an increasing extent as a safeguard to the lives of the toilers in our coal mines charged with explosive gases. In the great majority of its applications electricity is used as an agent—a tool, so to speak—for producing effects hitherto obtained less perfectly and less extensively by other means. Telegraphy and telephony, however, have introduced a really new thing into the world. True, the word "telegraph" was applied to an instrument—the semaphore—which preceded that which we mean when we use the same expression; but its operations were so limited—darkness or fog suspending them entirely—that no real comparison between the apparatus of Wheatstone and Morse and their so-called mechanical predecessor can be instituted. The operations of the telephone as yet are of a limited character, but even as at present developed are of great interest. Electricity has been the means of affording employment to a very large number of persons. It would seem that in the United Kingdom there are at present solely employed in connexion with British land telegraphs 23,868 persons; submarine cable companies (mainly British), 6,000 persons; telephone companies, 2,500 persons; electric lighting, 5,000 persons; and cable making and allied businesses, 5,000 persons; making a total of 42,368 persons. Add to these the individuals that cannot be classified, who must amount in the aggregate to at least an equal number, we arrive at a total approaching 100,000, in round numbers, of persons dependent for their employment on the various operations directly connected with electricity in these islands alone, besides a very large addition to the output of various trades caused by its consumption of the materials they produce. The employment of 100,000 persons means the support of at least 300,000 of the community. An unusually large proportion of young, or at least unmarried, people of both sexes minister to the calls of electrical work, and hence the average family is taken at three instead of the usual calculation of four and a-half or five. If these figures represent even an approach to the truth, it is evident that throughout the earth there must be 5,000,000 of people at least who would have to seek for other means of subsistence if electricity and its commercial applications had not been made known to man. It is little more than fifty years since the powers of the new agent were first turned to practical account, and since that time the record has been one of continuous and unabated progress. Discovery has succeeded discovery, and invention has followed upon invention. At present many fields are entered upon, but scarcely trodden. Electro-motors and their like have clearly an unknown, an immeasurable, field before them. What is done is as nothing to what will be done. The fusion of the influences of sound and light, the laws of heat in relation to the power we are considering, and its equally important bearing upon those of acoustics, open up so many directions in which we may look for future researches to make much that now shows, as it were, through a glass darkly clear and distinct, if not to ourselves, at least to future generations.

ROYAL SCHOOL OF MINES.

On the 9th inst. Mr. F. Rutley commenced a course of six lectures to working men, on "The Use of a Collection of Minerals," the lectures forming one of a series of courses arranged under the direction of the Science and Art Department. The first five lectures deal with crystals, and the last will be on some minerals of industrial importance. In pointing out the difficulties that so frequently beset the commencement of the study of crystallography, the lecturer dealt on the admirable clearness with which the three introductory cases to the mineral collections at Cromwell Road Museum had been arranged. A careful attention to these would give, he said, the key to the whole subject. Crystallography could never be learned from books, but with the help of some fine specimens of crystals that could be well seen in the theatre, the difference between bodies in an "amorphous" and a "crystalline" condition was explained. The blackboard was used to illustrate the way in which some crystals were built up.

ROYAL SOCIETY OF EDINBURGH.

At the special meeting on the 6th inst., after several papers had been read, Mr. J. T. Bottomley exhibited a number of flint-glass globes, manufactured at the St. Rollox Glass Works, Glasgow. These contained curious internal cavities. Mr. Bottomley stated that he personally

watched the operation of making these balls, in company with the engineer of the Forth Bridge. When the liquid glass at a great heat was removed by the maker's rod it cooled in the annealing quicker on the outside than in the inside; and after a skin was formed on the outside, small cavities were suddenly seen in the inside; and these cavities sometimes, as in the case of quicksilver, joined together into one large cavity when the ball was formed, it was cut off from the stalk, and the cut surface was ground smooth. One was exhibited without any internal cavity; this was formed with extreme care in the cooling. Professor Tait remarked that care should be taken in polishing the cut part, for he had no doubt that the negative pressure in the cavities was enormous, and if the slightest communication were made between the outer air and the cavity, there would be a violent explosion. He also mentioned the trouble he had in getting solid iron drops when the iron in its molten state is gradually dropped in water. In the interior there were cavities as in the glass. The engineer of the Forth Bridge was of opinion that much more care should be taken in the castings of iron for bridges and other purposes, as any interior cavities excited a negative pressure. No one was able to state definitely what was in the cavities, but Professor Crum Brown suggested that it might be carbonic acid absorbed from the glass in cooling.

LONDON MATHEMATICAL SOCIETY.

On Thursday, January 12th, Sir J. Cockle, F.R.S., president, in the chair, the following communications were made:—The Theory of Distributions—Captain P. A. Macmahon, R.A.; On the Analogues of the Nine-Points Circle in space of Three Dimensions—S. Roberts, F.R.S.; On a Theorem Analogous to Gauss's in Continued Fractions with applications to Elliptic Functions—L. J. Rogers; A Theorem connecting the Divisions of a certain Series of Numbers—Dr. Glaisher, F.R.S.; On Reciprocal Theorems in Dynamics—Prof. H. Lamb, F.R.S.

WOLVERHAMPTON LITERARY AND SCIENTIFIC SOCIETY.

Professor Norman Lockyer, F.R.S., gave a lecture on "Sun Spots," in the course of which he remarked that on the earth the great variable element was the aqueous vapour, which assumed so many different forms. In the case of the sun the variable element was metallic gases, such as iron, manganese, etc. The cause of the sun spot was a downcast shaft or cyclonic depression, and where there was a downcast shaft there must be a reaction or an upcast shaft. When the falling matter struck the sun the reaction produced the red flames of hydrogen gas. These rose not from the surface of photosphere, but from the kernel. He added that the sun spots appeared in cycles of eleven years' duration, which meant that they began in a very small way, and at high latitudes. They went on increasing in number and size as they drew nearer the sun's equator. Observations commenced in the year 1879, when there were very few spots, showed that they consisted almost entirely of iron vapour. In 1884, when there were most spots on the sun, there was no iron vapour at all, and later on there appeared the gas of a metallic substance, for which they had no corresponding gas on the earth—at least none that had been discovered. When the sun spots had reached their maximum, as every telegraph operator knew, it was very difficult to get messages along the wires. This was owing to the earth currents which no doubt spoke their own language if they could be interpreted. Mr. Chambers had observed that in one part of India the fall of rain during the monsoon had a corresponding relative value to the sun spots. The greater the area of the sun spots the greater the fall of rain during the monsoon, and the greater the fall of rain the cheaper rice became.

EDINBURGH LITERARY INSTITUTE.

Sir Robert Ball, Astronomer-Royal for Ireland, recently delivered a lecture on Comets. The lecturer dealt with comets of all kinds and times, with shooting-stars and meteorites. Comets, he explained, revolved in elliptical orbits, and to accomplish the full length of their circuit many of them needed such a length of time that they could not repeat a visit to the earth. The closer the examination that had been made of comets, the more apparent had it become that there was no solidity in them. They were of extreme tenuity, and so light that it had been found impossible to weigh them. People lived, or had lived, in continual dread of a comet coming into collision with the earth, and shattering it into fragments. Collision between the earth and a comet occurred in 1861, and because of the non-solidity of cometic matter this world had sustained no damage. He mentioned that carbon was largely found in the composition of comets, and defined a shooting star as a small object moving through infinite space. The opposition that met a shooting star when it entered the atmosphere of the earth engendered a frictional heat, which in turn showed to the world below a golden ball of fire. On a night when the sky was full of shooting stars it had so happened that the planet of the earth had got into a great cloud of the bright illuminants. The knowledge which had been gained about meteorites showed that in all likelihood they had, ages ago, been thrown into space by very powerful volcanoes, and that after wandering hither and thither had happened again to come under the attractive influences of their mother earth. Time was when comets and shooting stars had been thought of ill-omen, but nowadays we should rather look upon them as interesting and beautiful visitors come to please and instruct, but not to hurt and destroy us.

MIDDLESEX NATURAL HISTORY SOCIETY.

At last meeting of this Society, Mr. Sydney T. Klein read a paper on "The Appearance in London of *Ephestia Kühniella* and the Remedy Provided by Nature." The insect referred to is a troublesome pest in the Mediterranean ports, and in the spring of this year was discovered in some large warehouses at the East end of London by Mr. Klein. Fumigating with sulphur and the hot liming of walls and floors were at once practised, but although immense numbers of the imagos were destroyed, the insects spread with great rapidity, until one warehouse was literally smothered, and flour to the value of many hundreds of pounds was so injured that it was unfit even for cattle food. The ova are deposited generally on the tops of the sacks of flour, and, speedily hatching, the larvæ at once burrow through the sack into the floor, in which they spin long galleries of network which much resembles wool. The larvæ are full fed in about four weeks, and then make their way out, swarming over the floors and walls of the warehouse. Mr. Klein had a colony at his private house for the purpose of experi-

menting; but found the larvæ increased and wandered to such an extent that he had to give up acting as host, and requisitioned the services of a number of hens, the plump larvæ being evidently appreciated by them. Hens were tried at the warehouses, but after ten minutes of gorging they relaxed their labours, and although they devoured enormous numbers, the larvæ continued to multiply. Several experts, entomologists, and specialists were consulted, without remedy being found; but when Mr. Klein made his monthly inspection in September, he found the tops of the sacks covered apparently with soot, which on nearer examination turned out to be enormous numbers of a small black fly belonging to the Ichneumonidæ. Nature had come to the rescue, and provided the remedy herself. Mr. Klein attributes the present visitation and remarkable ravages to the hot and dry season, for the larvæ originated in some meal shipped from Fiume over two years ago. The Ichneumon is probably new to science, for it has been submitted to several specialists—so far without recognition. Specimens of imagos, pupæ, and larvæ of *Ephestia Kühniella*, together with the Ichneumonidæ are now on view in the Natural History Department of the British Museum at South Kensington.

BRISTOL NATURALISTS' SOCIETY.

Dr. A. J. Harrison in a paper on "The Ballast-bag of the Seal," said, "The seals are carnivorous mammals divided into two classes—the *Phocæ*, or common seals with rudimentary ears, and the *Otariæ* (sea-lions, bears, elephants), which have the ears developed. The *Phoca vitulina* is the common English seal, which is easily tamed, becoming much attached to the keepers; but the *Otariæ*, which inhabit the waters of the Southern hemisphere and abound at the Cape, formed the principal part of Dr. Harrison's subject. According to the fishermen, the *Otariæ* have an internal pouch known as the "ballast bag," because it is always found to contain a number of rounded stones. The presence of these is accounted for by saying that when the animals grow very fat, they become so buoyant as to be unable to sink below the surface of the water without the aid of some ballast, which they secure by swallowing stones. This theory implies the possession by the seals of considerable reasoning power. Observations have shown that the so-called ballast-bag is only the stomach; and accordingly some people have suggested that the stones are intended to assist in the trituration of food, in somewhat the same manner as in the gizzard of fowls. Other persons suppose the stones subserve no useful purpose, and are accidentally introduced with the food, or in play. In the seals and sea-lions at the London Zoo similar rounded stones have been found, large numbers of which are quite foreign to the geological character of the district. A Newfoundland seal which died at the Clifton Zoo in 1886 was examined by Dr. Harrison, who found in the stomach, gravel, nuts, and pieces of stick.

BIRMINGHAM AND MIDLAND INSTITUTE.

Sir Robert S. Ball, Astronomer Royal for Ireland, gave a lecture on "The Visible Stars." Speaking of the difficulty of obtaining a full knowledge of the subject, Sir Robert said that all that could be seen of the stars outside our own system—even with the telescope—was a number of points of light. The only things the astronomer could observe with regard even to the nearest of these stars were their position and their movements. One of the earliest discoveries with regard to them was the fact that many of the so-called stars really consisted of two spots of light instead of one. To separate the two, however, required a very good telescope. It was found by repeated observations extending over long periods that one of the bodies forming what was called a double star revolved round the other, and this fact was instructive, inasmuch as it afforded the means of proving that the same laws of gravitation that guided the planets round our sun guided the movements of these distant stars or suns. Of late years much attention had been bestowed on these distant bodies, and some very beautiful discoveries have rewarded the astronomer. For instance, in many cases the two stars were found to afford a most exquisite contrast of colours. The periods of the revolution of the satellite round the principal star varied considerably. One was fifty or sixty years, while others were about 900 years. One of the chief interests of these observations was the power it gave us to estimate the weight of the stars. For instance, Sirius had a satellite which revolved in forty-nine years. The period for an imaginary planet revolving round our sun at the same distance would be 225 years, and from this was deduced the fact that Sirius was thirteen times as big, and the satellite nine or ten times as big as our sun. The solar system of which Sirius is the centre contained about twenty times the amount of matter contained in our solar system. Though Sirius and its twin star were so nearly alike in size, the latter was a very much less brilliant object. Sirius was far and away the most brilliant object in the sky, but its companion was excessively faint, and could only be seen in the best telescopes under most favourable circumstances. The explanation of this was that the satellite had cooled down to a large extent. This discovery opened up a most enlarged view of the universe, for in addition to stars and vistas of stars we saw there must be countless millions of bodies in space devoid of luminosity, and consequently invisible to us.

INSTITUTION OF CIVIL ENGINEERS OF IRELAND.

In his presidential address, Mr. John Purser Griffiths, at the meeting on Dec. 7th, reviewed the progress made by the institution during the past fifty-two years. He also described the progress that had been made in the various great hydraulic engineering works now being constructed.

CARDIFF NATURALISTS' SOCIETY.

Mr. R. W. Atkinson, in an exhaustive paper on the tobacco plant, pointed out as a result of his investigations into the composition of the ash of this plant, that it can only be cultivated successfully in soils containing potash salts. When these are wanting kainit is recommended as a manure. The ash of good Virginian tobacco has as much as 20 per cent. of potash, whereas the ash of some specimens recently grown at Llandaff was found to contain only 2·89 per cent. of this important constituent.

SOCIETY OF CHEMICAL INDUSTRY.

A meeting of the Glasgow and Scottish section of the Society of Chemical Industry was held on the 10th inst., Mr. J. J. Coleman, presiding. A paper by Professor

Carnelly, D.Sc., University College, Dundee, and Mr. Frew was read, in which an interesting description was given of the action of water on lead, showing that corrosion was much greater when exposed to air than when air was excluded. Mr. J. J. Coleman, F.R.S.E., F.I.C., communicated a paper on "The present aspects of the sewage question." He first glanced at the position of matters in Glasgow fifteen years ago, and remarked that in spite of Royal Commissions, Acts of Parliament, and deputations, affairs remained *in statu quo*, sewage flowing into the Clyde as usual. Mr. G. G. Henderson, M.A., B.Sc., exhibited Franke's gas burette.

TECHNICAL EDUCATION NOTES.

BIRMINGHAM.—Mr. Turner is giving an evening course of practical lessons on Qualitative Chemical Analysis at Mason's College under the auspices of the South Staffordshire Institute of Iron and Steel Works Managers.

THE APPRENTICES' EXHIBITION.—At the distribution of awards in connection with this exhibition, Sir John Jennings, the chairman, remarked that it was generally admitted that to form an expert workman in mechanical and in many other trades an apprenticeship was absolutely necessary. Technical schools were, in his opinion, not only useful but indispensable, but their function was to supplement, not to supersede, apprenticeship.

BELGIUM.—A report just published by the Foreign Office describes the working of the Institut Supérieur de Commerce of Antwerp. The college at present contains 150 pupils, a third of whom come from foreign countries. The special character of the instruction is described as "practice combined with theory." Thus if the subject under consideration be sugar or coffee, or some mineral or chemical product, the course of instruction would not only include the commercial operations connected with the purchase or sale of these commodities, but would also embrace a thorough examination into the nature of the product from a scientific point of view. An extensive museum of mercantile productions, natural or manufactured, a chemical laboratory, a library comprised of books relating to the subjects treated in the institute, and a numerous collection of geographical and statistical maps form part of the institution. A class for the study of the new language "Volapuk" has been established during the last term as an experiment, and it is said to be now taught in the commercial schools of France, Germany, Austria, and Russia.

BROMLEY.—At the annual meeting and distribution of prizes at the School of Science and Art at Bromley, Kent, on the 17th inst., Sir John Lubbock remarked that Mr. S. Smith, one of the Commissioners on Technical Education, had wisely said, as the result of his experience, that it was not so much the longer hours and lower wages of continental workmen, nor the tariffs, which were having such objectionable influence on our industries, but rather, in nearly all instances, the great attractiveness of the goods themselves, which had been made by workmen who had received special training in schools. If we had spent one tithe of the treasure which we sent abroad every year to buy the produce of the skill of other countries on the training of our own people, we should have been making these goods ourselves. We were apt, indeed, to forget how much we owed to science, because many things which were in reality scientific discoveries had become so familiar to us that we looked upon them almost as a matter of course. The electric light was still felt to be a triumph of science, but we forgot sometimes that the common candle was the result of a whole series of chemical discoveries. The Chinese were said to have examined candidates for the army until lately in the use of bows and arrows. We could see the absurdity of this, but we were not free from the same error ourselves.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE STAR OF BETHLEHEM.

During the month of December last the planet Venus happened to arrive at its maximum brilliancy as a morning star. Thousands of persons, who are easily influenced by superstitious fears, beheld the planet with sacred awe, and asked, "Is that the star of Bethlehem?" When Venus appeared last summer as an evening star, a great number of persons in England and America asked the same question. A large number of letters have been received by the Astronomer-Royal upon the subject. In his reply, which has appeared in public, he says: "For some *unaccountable* reason the planet Venus has been supposed by some to be a reappearance of the star of Bethlehem." Sir R. S. Ball, who recently delivered a course of lectures on astronomy, at the Royal Institution, referred to his correspondence upon the same subject, and said, "Of course it sometimes happened that Venus was seen as a bright morning star at the Christmas season," and he supposed that that was the origin of the idea. The fact is, the idea had its origin in a sensational article which appeared three or four years ago in a well-known religious periodical (noted for its sensational articles), which has a large circulation in England and America. The writer of the article gave an account of some events which were then about to commence, and were to last over a period of ten or twelve years. The names of some noted persons in Europe were given who would take part in the events which would startle the world. But time has proved the fallacy of these prophetic assertions. It was stated in the article that during this period the star of Bethlehem would appear. The writer knew that a star was expected to appear, and made the astounding assertion that it was the "Star of Bethlehem." Hence when our "old friend Venus" appeared, thousands were alarmed, and believed that it was the star of Bethlehem.

The expected star appears about every 300 years, and is the one supposed to have been seen in the year 945 A.D., again in 1264, and in 1572. Tycho Brahe, the astronomer, informs us that he saw it on November 11, 1572. It appeared in the constellation of Cassiopeia. This remarkable star surpassed the brilliancy of the planet Venus, and changed its colour from time to time. At its first appearance it was white for two months, and then changed to yellow. In the spring of 1573 it became red, and in May its white colour returned, and remained so up to the time of its disappearance, which took place in the month of March, 1574. There is a small star now under telescopic scrutiny, because astronomers believe it to be the one seen by Tycho Brahe. Should it suddenly blaze out, as it did in 1572, the display will be very interesting. Various new stars are recorded in history, which afterwards have shone with great splendour for a short time, then gradually faded away until they ceased to be visible. Thus Pliny asserts that the appearance of a new star in 130 A.D. was the occasion of inducing Hipparchus, the astronomer, to construct his famous catalogue of stars.

J. WEBB.

WATER SNAILS.

In answer to your correspondent, "Inquirer," I may state that I am the possessor of several kinds of fish, molluscs, etc., and have repeatedly observed the ascent of water-snails to the surface of the water. I believe that this is due to the presence of an opening near the head (somewhat equivalent to the "air-bladder" of fishes), into which, by means of muscles, air may be taken or expelled as the case may be, resulting in the rise or fall of the animal. Buffon mentions this in his "Natural History," and I have myself noticed the snail with the aperture above water, apparently taking in air.

Your correspondent does not mention what kind of water-

snail he has. I may venture to remark they are either species of the genera *Planorbis* or *Limnæa*, as these seem most addicted to changing their positions in the manner described. F. P. P.

A CURIOUS PHENOMENON.

The curious phenomenon pointed out by "Observer" in SCIENTIFIC NEWS (p. 22) seems to me to be a case of mirage by reflection, seeing that the images in the sky of the shore objects were standing up in the natural position and not inverted as in the ordinary refraction-mirage. The most remarkable instance of reflection-mirage which we have on record is that which was photographed on the 17th of June, 1886, off the coast of Madras. On a calm and clear day a boat floating, not far from the port of Madras, and sailors in the act of rowing were reflected in the upper air. The images were distinctly seen in the sky, and when the tide receded the dark image, laid bare, was reflected in the same way. Optical appearances of this kind generally have the images turned upside down. Vince records that at Ramsgate on certain occasions he saw from the water's edge the cliffs near Calais, which, in clear ordinary states of the atmosphere, are generally not visible even from the highlands about that place.

The ordinary mirage of the desert, which gives the parched traveller the impression of the existence of a sheet of water, is due to the rarefaction of the air in the immediate neighbourhood of the hot sand. The wonderful images recorded by Scoresby in Arctic regions can be fully explained by one intermediate stratum (or more) between the cold air over a frozen sea and a warm stratum fifty to a hundred feet aloft. In Scoresby's drawings the images are sometimes direct and sometimes inverted. Inverted images seen in this way are magnified as regards height; direct images are usually much diminished. On the 14th of December, 1869, between three and four oclock in the morning, the Parisians who were passing on the quay, saw the Louvre, the Seine, and its ports reflected in the sky; but all the images were inverted as in a mirror placed horizontally. The moon was then beautifully clear, part of the heavens was veiled with particular clouds which shone with the brightness of an aurora borealis. In the previous year the celebrated æronaut, Gaston Tissandier, observed a phenomenon quite analogous to the mirage by reflection, pointed out by "Observer," when on a balloon ascent he was over the North Sea. The sea was reflected in the upper regions of the air; and he, with his friend, M. J. Duruof, saw the image of a steamer which was sailing below. Bernard, of St. Pierre, tells us of the artist Vernet, who in Italy saw the image of a whole town thrown by reflection on the upper sky. Meteorological reports give numerous instances of similar appearances. The mirage in our day does not occur very frequently; it is always interesting to observe and to take note of. But this photograph of the beautiful reflected mirage will always be of great value in the discussion of the interesting phenomenon. READER.

TRANSMISSION OF SIGHT-IMPRESSIONS.

Great attention has lately, in consequence of certain inventions, been drawn to the transmission of sound and even of speech to a distance. But is there any rational hope of our being able to *see* objects and events at a distance? Leaving out of question matters of pure science, I may ask would it not be invaluable if the manager of a manufactory or a mine could, on looking into a camera, and connecting certain wires, see what was being done in any part of the concern?

LYNX.

ANSWERS TO CORRESPONDENTS.

J. DE D.—We have no objection to inserting a letter on the subject you refer to, provided it is not more than half a column in length.

F. A.—We shall be glad to know the result of your experiments. The subject is an interesting one.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

A DETACHABLE CUFF.—Mr. G. Benson, of Belfast, has patented a detachable cuff. According to this invention, the outer fold or cuff proper has an inner fold sewn to it. The edge of the wristband of the shirt is concealed between the inner fold and back part of the outer fold or cuff proper.

TENNIS NET STRETCHER.—A stretcher for tennis nets has been patented by Messrs. Malings and Muckle, of Woolwich, Kent. The net cord is attached to a swivel fitted to a screw which passes through the pole, and provided with a handle by which the cord and attached net may be stretched.

PORTMANTEAU.—Messrs. W. H. and B. Jones, of Wolverhampton, have patented an improvement in portmanteaus. It consists essentially of applying castors to the bottom of the portmanteau or box. The castors are attached to bars of wood, which are secured to the bottom of the portmanteau by screws and by end clips.

WINDOW FASTENER.—A fastener for windows has been patented by Mr. T. Stow, of West Bowling, Bradford, Yorkshire. The fastener consists of a screw, which passes through a block pivotted to supports on the lower window-sash, and engages a pillar secured on the upper sash. When the screw is released from the pillar it can be turned vertical, or nearly so, to allow the sashes to pass.

BOOT AND KNIFE CLEANING MACHINE.—A rotary machine for cleaning boots, knives, etc., has been patented by Mr. A. E. Haslam, of Cheetwood, Manchester. The machine consists of a horizontal fly-wheel, which receives its motion from a treadle by means of a connecting rod. The fly-wheel rotates a shaft by means of a friction pulley, and to this shaft brushes, etc., are attached.

TOBACCO PIPE.—Mr. H. Callabine, of Sheffield, has taken out a patent for improvements in tobacco pipes. The stem is formed into a barrel for a piston, inserted from the bowl end and fixed by a cap or plug. A groove or passage for the smoke is made above the piston. Liquid is drawn in by the piston for cleaning purposes, and a pin is inserted in the piston-rod for cleaning the bowl passage.

FABRIC FOR SURGICAL DRESSINGS.—Mr. Gamgee, of Edgbaston, Birmingham, has patented a fabric for surgical dressings. A layer of bleached absorbent cotton is enclosed between two pieces of gauze or muslin. The fabric is perforated with holes to permit free drainage from the wound; these holes may extend through the absorbent cotton only, or through the whole fabric.

RESPIRATOR FOR USE IN IMPURE ATMOSPHERES.—An apparatus to permit breathing in impure atmospheres has been patented by Messrs. Runge and Stude, both of

Bremen, Germany. A current of air from the outside is made to pass over the front of the face so as to enable the wearer of the appliance to breathe, and also to protect his eyes from smoke. The helmet is provided with a space, between the lining and the exterior, which is supplied with air through small pipes branching from a main pipe, the air escaping through the rim of the helmet thus keeping back the surrounding smoke, etc.

A PIANOFORTE has been patented by Mr. T. J. Brinsmead, of 18, Wigmore Street, Middlesex. The patented improvements in the pianoforte are three in number. (1) The belly-bridge is continuous, and the bars of the framing are arched so as to pass over it, the arch being continued on each side to form legs, which pass through holes in the sound-board. (2) The wrest-plank is of iron and cast in one with the frame, the wrest-pins being driven into holes lined with linen or other textile fabric. (3) In horizontal pianos two dampers are placed one on each side of the string at some distance apart, in order to more effectually stop the vibration and prevent harmonics.

CIGARETTE PAPERS.—A machine for cutting and gumming cigarette papers has been patented by Mr. J. J. Aubert, of Paris. The paper passes from a roll cylinder on which it is wound, under a series of circular knives, which cut it into as many bands as there are knives; then under the wicks of a paste receiver, from which the edges take up a certain quantity of paste, which is dried as the paper passes over a hollow drum heated to a sufficient temperature; and the paper is finally received upon a winding-up cylinder on which the paper is cut lengthwise and then removed and cut up into lengths by an ordinary paper-cutting machine.

ALARM THERMOMETER.—Mr. J. E. White, of Syracuse, New York, U.S.A., has patented an alarm thermometer. In this invention the terminals of the alarm are both placed at the top of the bore, to prevent the corrosion that occurs in one usually inserted in the mercury of the bulb. The bore of the thermometer is spread out at the top into a conical chamber, the outside of which is formed into a lip. The top of this chamber is plugged by a cork, through which the terminals of an electric alarm are led, and the whole is secured by a cap of cement. When the mercury rises into the conical chamber the circuit is completed for the alarm.

SNOW-MELTING MACHINE.—A machine for dispersing snow has been patented by Mr. F. Botting, of Portman Square, London. At the bottom of the machine, extending from back to front, is a gilled trough provided with an outer jacket, thus forming a steam space between each of the gills. The snow to be dispersed is shovelled into the trough, which, heated by the steam, melts the snow in contact with it. Above the trough is fitted a hollow shaft provided with revolving arms, also hollow, which as they revolve pass between the gills and crush the masses of snow lying in the trough. The steam passing into the hollow arms heats them, and the latter, besides acting as crushers, carry up a portion of the snow which is melted, the water falling between the arms on to the trough.

ANNOUNCEMENTS.

HOLLAND.—A National Art Industry Exhibition is to be opened at the Hague this summer.

MELBOURNE EXHIBITION.—A meeting was held at the Ministry of Commerce in Paris, on the 13th inst., to decide on the best mode of preparing for the participation of French commerce in the Melbourne Exhibition.

KING'S COLLEGE.—Mr. G. S. Johnson, F.C.S., has been appointed Senior Demonstrator, and Mr. H. Jackson, F.C.S., Junior Demonstrator in the Chemical Department. Mr. Ashley Gibbings, M.R.C.S., L.D.S., has been appointed Professor of Dental Surgery and Dental Surgeon.

THE PARIS EXHIBITION OF 1889.—According to *Industries*, rumours are current in Paris that, notwithstanding official announcements, it is possible that the date of the opening of the International Exhibition will be postponed till 1890, in order to avoid the political complexion which it would have if it were to be held next year.

LECTURES ON ELECTRICITY FOR LADIES.—A course of six elementary lectures on electricity was commenced by Mrs. Ayrton at 2, Upper Phillimore Gardens, W., on January the 17th, and they will be continued on the five following Tuesdays, at 5·15 p.m. The course, which will be fully illustrated by experiments, will be strictly elementary, and will presuppose no scientific nor mathematical knowledge.

INSTITUTION OF MECHANICAL ENGINEERS.—The forty-first annual general meeting of this society will be held at 25, Great George-street, Westminster, on Thursday, 2nd, and Friday, the 3rd of February. Mr. J. Richards' paper on "Irrigating Machinery on the Pacific Coast" will be discussed, and the following papers will be read: On the position and prospects of Electricity as applied to Engineering, by Mr. W. Geipel, of Edinburgh; Third Report of the Research Committee on Friction; Experiments on the Friction of a Collar-bearing.

CAMBRIDGE.—Mr. Thomas Cecil Fitzpatrick, B.A., First Class Natural Sciences Tripos, Part I., 1883, First Class Natural Sciences Tripos, Part II. (Physics), 1885, has been appointed to a fellowship at Christ's College. The following have been elected to scholarships at Christ's College:—Mr. T. Masterman, University School, Hastings, £70, for natural science; Mr. T. M. Twentyman, King's College School, London, £60, for mathematics and natural science; Mr. V. V. Chetty, Messrs. Wren and Gurney, £40, for mathematics; Mr. H. N. Weller, St. Paul's School, £40, for natural science.

MEDICAL ELECTRICITY.—A scheme is on foot for founding an Institute of Medical Electricity, having the following objects:—1. To provide an institute where, or in connection with which, people of small and limited means may obtain electrical treatment under the direction of qualified medical men, for the cure and relief of diseases, at moderate fees. 2. To encourage by scientific investigation and other approved means the development of the science of medical electricity. 3. To provide a means by which medical men can obtain the use of reliable electrical apparatus and instruments for the treatment of their patients either at the institute or elsewhere. For further information communications should be addressed to Mr. H. Newman Lawrence, 16, Clifford's Inn, Chancery Lane, E.C.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The International Geological Congress will hold its fourth session in London from September 17th to 22nd (both inclusive), 1888. The organising committee has nominated the following officers:—Honorary president, Professor T. H. Huxley, F.R.S.; president, Professor J. Prestwich, F.R.S.; vice-presidents, the President of the Geological Society, the Director-General of the Geological Survey, and Professor T. McK. Hughes, M.A.; treasurer, Mr. F. W. Rudler; general secretaries, Mr. J. W. Hulke, F.R.S., and Mr. W. Topley. The subscription is 10s. This entitles the members not only to attend the meetings and excursions, but to receive, post

free, the report of the Congress and the other ordinary publications, such as the reports of the International Commissions, the proceedings, and excursion programmes. All correspondence respecting the Congress should be addressed to Mr. W. Topley, 28, Jermyn-street, London.

—PRIZE ESSAY ON DRINKING WATERS.—In 1893 a prize of £1,000, offered by the King of the Belgians, will be awarded for the best paper on the method of providing large towns, especially Brussels, with a cheap and abundant supply of good potable water. The competition is open to all the world. Further information may be obtained on application to the Minister of the Interior, Brussels.

DIARY FOR NEXT WEEK.

Monday, Jan. 30.—Society of Arts, Cantor Lecture, at 8 p.m.—*Yeast, its Morphology and Culture;* Mr. A. Gordon Salamon, F.I.C.
Bradford Naturalists' Society, at 7.30 p.m.—*Plant Lore;* Mr. B. Spencer.
London Institution, at 5 p.m.—*The Ptolemies;* Rev. William Benham, B.D.

Tuesday, Jan. 31.—Society of Arts. Applied Art Section, at 8 p.m.—*The Monumental Use of Bronze;* Mr. J. Starkie Gardner, F.G.S.
Royal Institution, at 3 p.m.—*Before and After Darwin;* Professor G. J. Romanes, F.R.S.

Wednesday, Feb. 1.—Society of Arts, at 8 p.m.—*The Sweating System, or the Functions of the Middleman in Relation to Labour;* Mr. D. F. Schloss.
Entomological Society, at 7 p.m.—*The Lepidoptera of Sikkim;* H. T Elwes, *with Notes on Seasonal and Local Distribution*, Mr. O. H. O. Möller.
Civil and Mechanical Engineers' Society, at 7 p.m.—*On the Use of Ammonia as a Refrigerating Agent;* Mr. T. K. Lightfoot, M.I.C.E.
Dundee Naturalists' Society, at 8 p.m.—*The Birds of Balgay;* Mr. R. W. Kerr.

Thursday, Feb. 2.—Chemical Society, at 8 p.m.
Royal Society, at 4.30 p.m.
Institution of Mechanical Engineers, at 7.30. Annual General Meeting.—*On Irrigating Machinery on the Pacific Coast;* Mr. John Richards.
London Institution, at 6 p.m.—*Atlantic and British Weather;* Mr. Robert H. Scott, F.R.S.
Royal Institution, at 3 p.m.—*Art Education;* Mr. H. Herkomer.
Camera Club, at 8 p.m.—*Photographing by Artificial Light;* Mr. J. F. Roberts.

Friday, Feb. 3 —Institution of Mechanical Engineers, at 7.30 p.m.—*On the Position and Prospects of Electricity as Applied to Engineering;* Mr. William Geipel.—*Third Report of the Research Committee on Friction: Experiments on the Friction of a Collar Bearing.*
Royal Institution, at 9 a.m.—*Ancient Microscopes;* Mr. Frank Crisp.
Royal United Service Institution, at 3 p.m.—*Speed as a Factor in Naval Warfare;* Rear-Admiral the Hon. Edmund R. Freemantle, C.B.

Saturday, Feb. 4.—Royal Institution, at 3 p.m.—*Experimental Optics;* Lord Rayleigh, F.R.S.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

Before deciding, send **2d.** for list of Second-hand **Lathes, Fret-saws, Mechanics' Tools.**—BRITANNIA Co., Colchester Makers of Engineers' Tools to the British Government.

Large assortment of **Tools,** etc., on view, 100, Houndsditch, London.—All letters to BRITANNIA WORKS, Colchester. *Bona-fide* makers of 300 varieties.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased; Ambers fitted.—W. GEORGE, 324, Essex-road, Islington, London.

Poultry, Pigeon, and Rabbit Nest Pans, Water Fountains, Feeding Troughs. Illustrated list free.—PRATT, Stoneware Works, Dudley.

Trouser Lengths, 5s. Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—HEWITT, 27, Winfield, Leeds.

Minerals, or Lias, or Carboniferous Fossils.—12 named specimens, 2s. 6d., free.—C. WARDINGLEY, 30, Blackwood-crescent, Edinburgh.

Gilding and Plating Taught.—PERKS, 47, Alexander-road, Richmond, Surrey. 20 years' practical experience with leading firms.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Castings, Parts, Materials, and Finished Models.—Catalogue, 2d.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

Mesmerism.—"This book is a very good one. Any one can learn the art from it."—*Weekly Budget.* 2s. 6d.—W. THOMAS, 22, Clarendon-road, Anfield, Liverpool.

Crayon Sketch from any photograph (returned uninjured), correct likeness, 15 by 11, 1s. each. Postage of one or more, 2d.—MR. COULTHARD, Bathwick, Bath.

Mechanics' Specialities.—20 large sheets fretwork patterns, 7d.; 200 turning patterns, 1s.; 300 stencils, 1s.—BELOW.

Fifty Conjuring Tricks, 1s.; 100 experiments, 1s.; photographs 100 eminent women, 1s.—COLLINS, Summerlays-place, Bath.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

BOOKS RECEIVED.

Management of Accumulators and Private Electric Light Installations—A Practical Hand Book. By Sir David Salomons, Bart, M.A., A.I.C.E., M.S.T.E. Third Edition, revised and enlarged. London: Whittaker and Co.

Biliousness: its Causes and its Rational Treatment. By A. E. Bridger, B.A., M.D., F.R.C.P. London: Henry Renshaw.

Playground of Science. A Series of Novel and Interesting Experiments. By Johnston Stephen. London: Truslove and Shirley.

The Naturalist's Diary. A Day Book of Meteorology, Phenology and Rural Biology. Arranged and Edited by Charles Roberts, F.R.C.S., L.R.C.P., etc. London: Swan Sonnenschein, Le Bas and Lowry.

Elementary Text-Book of Physiography. By W. Mawer, F.G.S. London: John Marshall and Co. Hull: Elsom and Co.

Schools of Forestry in Germany. With addenda relative to a desiderated British National School of Forestry compiled by Rev. John Croumbie Brown, LL.D. Edinburgh: Oliver and Boyd. London: Simpkin Marshall and Co.

Animal Biology. An Elementary Text Book. C. Lloyd Morgan. London: Rivingtons.

Short Studies from Nature. London: Cassell and Co.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 5. (*New Series.*) FEBRUARY 3rd, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

THE PEOPLE'S LECTURE SCHEME.—These lectures, arranged by the London Society for the Extension of University Teaching and by the Gilchrist Trustees, have been decidedly successful. It is known that ten courses, each of three lectures, have been delivered in different parts of London. The total attendance has exceeded 20,000, or an average attendance of upwards of 650 at each lecture. It is to be noted that in the East of London the audiences were larger and more appreciative than at the West. This is in one sense an encouraging feature, showing that the masses are eager for sound knowledge, perhaps the more because it has been hitherto but sparingly placed within their reach. Eight of the courses of lectures were scientific and two literary. Dr. Roberts, the Secretary of the Society, states that the "success was in direct proportion to the personal effort expended in the district."

ANALYTICAL LABORATORIES IN SPAIN.—The Ministry of Public Works has issued a decree for the prompt establishment of twenty chemical laboratories in the chief cities of Spain, for the special purpose of the examination of wines, alcohol, and other beverages. The samples after analysis are to be kept in depots, classified according to the regions where they were produced. All adulterations detected are to be made public. The heads of the laboratories are commissioned to give information as to the best preparation, care, and preservation of wines. Every three months, a report is to be furnished by the chief official as to the analyses made of the various samples, and copies of this report are to be supplied to all Spanish consular agents. Prizes are to be awarded annually for the best and most successful preparation and preservation of wines.

THE APPLICATION OF ELECTRICITY.—In his inaugural address, the President of the Society of Telegraph Engineers and Electricians, dwelt chiefly on electric communication between distant places. He shows that on comparing the numbers of telegrams sent in the different towns it appears that the nature of the trade of a locality is of more importance than its absolute quantity in determining the use made of the telegraph. Sea-ports rank in this respect before inland industrial centres. Liverpool sends yearly rather more than three messages per head of its population; Newcastle-on-Tyne rather more than 3½; Cardiff somewhat less, Newport (Monmouth) 4, and West Hartlepool 3½. On the other hand Oldham and Blackburn, each with an industrial population exceeding 100,000, do not rank at all among the 52 towns sending the largest numbers of messages, though many places do which are much smaller.

PROBABLE WATER FAMINE.—To the surprise of many meteorologists the unusually dry summer and autumn of 1887 have been succeeded by a winter which, so far, has also been exceptionally dry. Unless February fills the "dykes" in its proverbial fashion, Liverpool and Manchester will be in danger of a water-famine in the spring and summer. The huge reservoirs in the Woodhead Valley, which supply Manchester, were very low in

August last, and there has since been no compensatory quantity of rain or snow. The annual rainfall on the moors around Woodhead has rarely been less than forty inches since rain-gauges have been in use. During the entire of 1887 it has not exceeded thirty inches. The amount of evaporation must also have been abnormally great, in consequence of the unusual prevalence of dry, easterly winds. The daily consumption of water in Manchester is now, we learn, greater by two million gallons than it was eight or nine years ago. A scarcity of water is particularly to be dreaded in view of the epidemic diseases raging in various parts of the country.

The Senses of the Lower Animals.—As will be seen in our Natural History notes, Sir John Lubbock has lately delivered a lecture to the Catford Hill Literary Society on this interesting and difficult subject. He remarked that both the physicist and the physiologist feel compelled to admit the narrow range of our senses. If the vibrations of the air which impress us as sound exceed 40,000 per second, we do not hear them. It has been asserted that the Death's-head Moth (*Acherontia atropos*) is the only lepidopterous insect which can utter a cry. It seems more probable that the voices of other moths are too acute to affect our ears. Again, of the luminous vibrations whose existence is demonstrated only one octave—about one-eighth part of the total—affects our eyes. Yet various experiments have rendered it probable that ants can recognise light which has for us no existence. They must thus see things which to us are invisible. The lecturer asked why should we refuse to believe that senses other than ours may exist? He considers that the antennæ of insects must be the organ of one such sense, which increases in delicacy with the complexity of their structure. Sir John Lubbock throws out the suggestion that inquiries into the ways of living beings will reveal to us stranger facts than we can gather from their structure.

The Telephone at the Belgian Exhibition.—The Executive of the Company who are getting up this Exhibition, or as they more magniloquently call it, "Grand International Competition of Science and Industry," aim at making a special feature of the general applications of telephony. To this end they contemplate establishing in the buildings and grounds a complete representation of the arrangements adopted for the telephonic service of a city. It is to enable visitors to communicate with persons in the theatres, restaurants, etc., in the Exhibition grounds. All the branch offices will be connected with a central station. The communications in the interior of the Exhibition are to be capable of extension to the central system of Brussels and the suburban and local services.

Patent Office Statistics.—The *Times* argues from the immense number of applications for patents during the year 1887—18,029, an amount never reached before—that we have "no reason for apprehending that the inventive faculty is decreasing in the country." However, a very large proportion of the most important of these patents are taken out not by natives, but by aliens residing abroad. Further, in a majority of instances where the manufacture of colouring-matters is concerned, the applicants never work their processes in this country and refuse to grant to others licences for so doing. Thus our patent-system, instead of fulfilling its original purpose of introducing new arts and manufactures into these realms is made, in such cases, the means of keeping them out. It appears that nearly one half of the applications for patents are abandoned even before completion. We may notice the "disproportionate growth of patents for trivial matters, toys, games, buttons, tobacco-pipes, etc." During the first nine months of the past year no fewer than 121 applications were made for improvements in automatic sale-boxes. It may now be taken as proven that no new stratum of inventive genius has been tapped by the new law. There is no reason to believe that the number of important inventions has been increased, or that many processes of value, which might otherwise have remained unknown, have been brought into effective action.

A New Human "Station" of the Stone Age.—M. E. Rivière has communicated to the French Academy of Sciences an account of traces of pre-historic human activity belonging to the neolithic period. He has made this discovery in the forest of Fausses-Reposes, in the parish of Ville d'Avray, and the Department Seine et Oise. The remains found consist of 300 flint instruments, entire or in fragments. Some of them were buried in the soil to a depth exceeding three inches. All these flints, save, perhaps, four or five, seem to have been obtained from the chalk-beds of Meudon. No human bones or animal remains of any kind have been found.

Eclipse of the Moon.—The observations of the eclipse of the moon on Saturday evening were not very successful, owing to the prevalence of clouds of more or less density over the greater part of Europe. At the Greenwich Observatory nine telescopes were prepared for observing the occultation of stars by the moon, but with five no observations were secured. The observers at the other instruments were more fortunate, eight disappearances and fourteen re-appearances being recorded. At mid-eclipse the moon was of a very dark red colour, due to the refraction of light by our atmosphere, but the disc was much more plainly visible than in the eclipse of 1884.

CHINESE KITES.

IN Europe, paper kites are merely an amusement for boys. But in Japan, and especially in China, they occupy the attention of grown men. Perhaps in consequence their construction has been more closely studied, and they are to be found in a number of different shapes. We have the opportunity of reproducing illustrations of some of the best designs from our contemporary, *La Nature*. These figures are drawn from models brought over to Paris by M. Huchet.

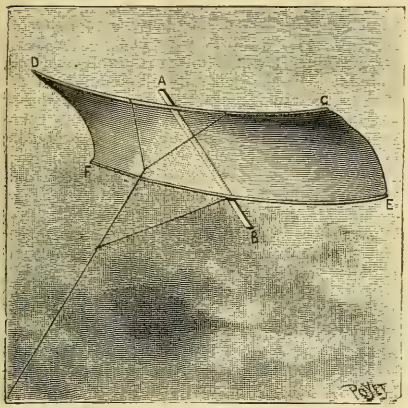


FIG. 1.

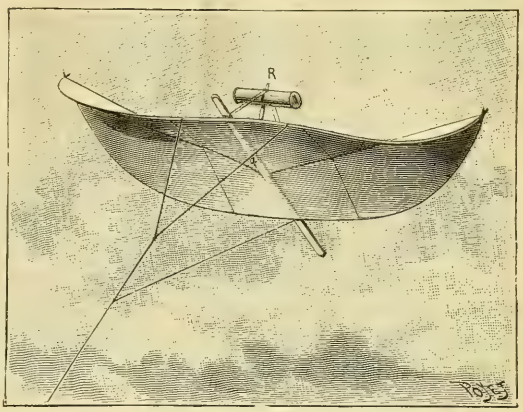


FIG. 2.

Figure 1 represents the simplest of these forms; its frame-work consists of a rigid rod of bamboo, AB, of two lateral rods slightly curved, CD, EF. A sheet of paper is glued upon this frame, and is but slightly stretched at the extremities CE and DF. By the action of the wind it forms at these extremities two bags, which keep the system in an excellent position of equilibrium. Our figure shows the method of attaching the strings by which it is fixed. These kites are about thirty-nine inches in breadth.

Figure 2 shows the "Musical Kite," so called because it is fitted up with a resounding-piece of bamboo, R, perforated with three holes. When the kite is in use, the air being drawn into the resounding-piece produces a very intense and plaintive sound, which can be heard at a great distance. The musical kite is constructed much like the former one, but the transverse rods of the frame are united at their two extremities, and give the entire system almost the appearance of two wings of a bird fastened to a central axle. The apparatus is sometimes of a great size, up to 11 feet in diameter.

The resounders are often three or four in number and are fixed above the kite. They give out a deep and very decided sound. According to M. Huchet, the musical kite is very common in China and in Tonkin.

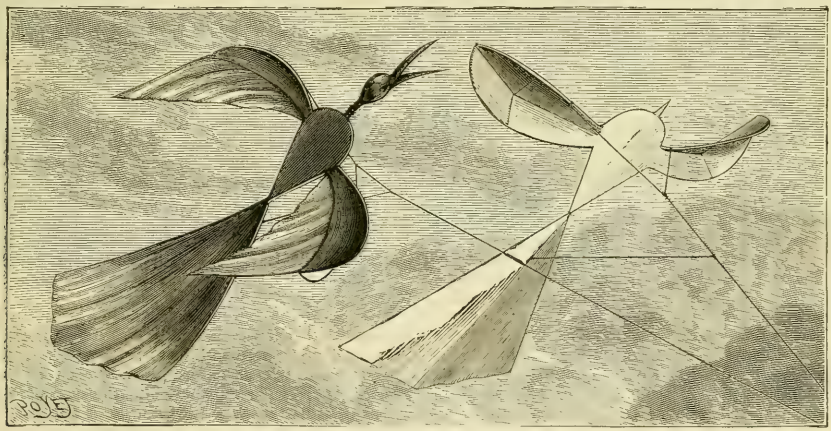


FIG. 3.

Sometimes hundreds of them may be seen hovering in the air in the vicinity of Hanoi. This toy, as we should regard it, is the object of certain superstitious notions, and it is supposed to exorcise evil spirits.

To this end, when there is sufficient wind, it is often attached to the roofs of houses where throughout the night it emits its plaintive notes after the fashion of the Eolian harp.

Figure 3 gives us the view of the "Bird Kite," the frame-work of which is shown at the right of the figure. It is often used in this state, but the Chinese frequently complete it by fixing a bird's head in front, and light papers attached to the wings. These papers are moved by the action of the wind, and simulate the beating of wings. The bird-kite, in its complete form, is shown at the left of the figure. It is sometimes a yard in height.

(*To be continued.*)

LITERATURE *VERSUS* SCIENCE.

THE "foreign relations" of Science, as a diplomatist might term them, are still in a "state of tension." The "Conflict between Religion and Science," described by Dr. Draper, due as it mainly was to misapprehensions, is now seen to be only a conflict between a more and a less imperfect knowledge, and has to a great extent ceased. Certain "advanced thinkers" of the present day even accuse us of being willing to sign a "concordat" with the theologians. But we are not, it seems, to be allowed to go on observing and experimenting in peace. Jealousies are springing up in a new and a very unexpected quarter—in literature! It may at first sight seem surprising that "men of letters," classical scholars, historians, moralists, and the like should regard the progress of Science with jealousy. We may wonder that they should use language like the following—"The time is near at hand, if we may judge our age by its tendencies, when the pursuit of Science will have to justify itself anew to the reason (?) of mankind." Another *litterateur* in commenting upon Trevelyan's Life of Macaulay, goes much further, saying: "He never thought it worth while to quit more attractive studies for the blind and groping physicism which now almost monopolises the name of Science. Whatever good it may have done in other directions, physical science has of late discouraged and debilitated moral and historical inquiry, which is of so much more value to the world" (!!). The same speaker, characteristically enough, comes forward as a champion of competitive examinations, and pronounces the gathering outcry against cram "not very respectable."

Some years ago there was founded at Leeds the "Yorkshire College of Science." Strong umbrage was taken both at the title of this institution and at its proposed constitution. A "college of science," we were told, was a "one-legged affair." Strange that the utterers of this censure saw nothing "one-legged" in colleges where science was totally excluded. Louder still was the outcry when the "Mason College," at Birmingham, was founded, and Professor's Huxley's able speech at its inauguration led to a singular counter-demonstration on the part of Mr. Matthew Arnold. The latter naïvely says that ten years ago, he "could not help being moved with a desire to plead with the friends of physical science on behalf of letters." This is very much as if he should plead with a recently emancipated slave on behalf of bondage!

We have not scope to dissect these outbreaks, and to show the errors and fallacies involved. But we must take good heed of the strong ill-feeling which they betray, and we must try to find out its cause. In one sense, like corresponding utterances to be found in the works of Carlyle and Ruskin, they may be pronounced quite gratuitous. The world is wide enough for both science and literature, and the minds naturally adapted to shine in the one are generally ill-qualified to do good service in the other. But the case stands thus: Until quite lately higher education in England has been almost exclusively literary, classical. The so-called "grammar-schools"—their very name is significant—imparted no knowledge save Greek and Latin, with sometimes a sprinkling of mathematics and of ancient geography and history. It is no exaggeration to say that many youths of the upper classes educated at these institutions were unable to write a note in decent English. Such was Dr. Butler's school, at which Charles Darwin was placed in boyhood, and where he naturally earned the reputation of being below the common standard in intellect. The sciences were totally excluded, being considered as devoid of any educational value, and even as "ungentlemanly." Darwin was once severely rebuked by the head-master for "wasting his time" on such useless subjects as chemistry.

Such being the grammar-schools, the universities followed suit. Cambridge, indeed, was always eminent in mathematics, and thus, as it has been aptly said, kept at least a narrow track open for science. But Oxford was, practically speaking, purely classical.

Since those days there has been much improvement. Scientific instruction has, to a greater or less extent, been introduced into many of our endowed schools. In the universities, laboratories for chemical, physical, and biological research have been established. But all these concessions to science, as it is needful to bear in mind, have been obstinately resisted by those whom Professor Huxley happily calls "the Levites of culture." Nor is scientific study, we believe, anywhere in Britain looked upon as equal in dignity and importance to literature. We doubt if there is any institution where a man may devote himself to science and may graduate accordingly, without being compelled either previously or simultaneously, to devote a very considerable part of his time to classical studies.

With the present condition of things, neither party is satisfied. Literature feels aggrieved at the concessions she has been forced to make, and seeks in various ways to render them practically null and void.

Science, on the other hand, claims for herself complete equality and independence. But she does not seek in the least to interfere with or to restrict literary studies. She does not aim at forcing a knowledge of physics, chemistry, or biology upon those whose peculiar tastes and abilities lead them to deal with words rather than with things. In short, as it has been tersely put: "Science is fighting for liberty, but literature for dominion."

This, then, is the true cause of the ill-will often shown by poets, novellists, historians, and orators against the study of Nature!

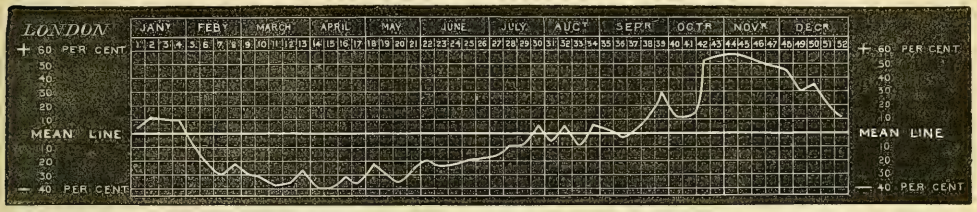
If we are asked why do we object to the arrangements now prevailing, we reply, because the field of modern intellectual activity is now too vast to admit of the student devoting his attention to more than a limited

portion. If he is to become a discoverer, one who can make some additions to the present sum-total of human knowledge—and unless this is his aim we can feel for him very little respect—he must concentrate himself upon those subjects for which he has most inclination, most aptitude, and most opportunity.

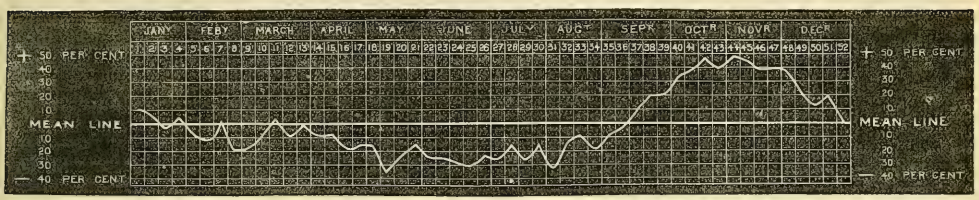
Further, Professor Galloway has found that among grammar-school pupils the juniors take up chemistry, and doubtless other sciences, better than the older boys. The reason of this is doubtless that classical culture the longer it is pursued, unfits the mind more and more for the observation of phenomena and for drawing right inductions from the facts recognised.

DEATHS FROM FEVERS, 1875 to 1884.

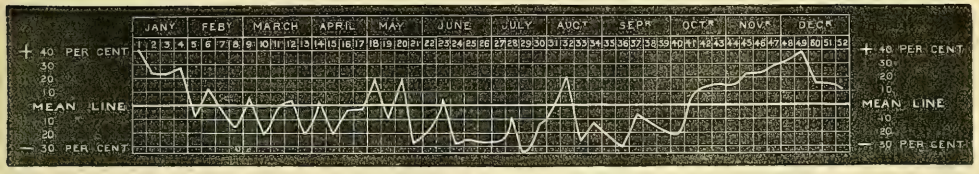
IN a paper read by Dr. Robert Barnes, F.R.C.P., at the meeting of the British Medical Association, in Dublin, last year, he gave some interesting tables showing graphically the deaths from various fevers in the decade from 1875 to 1884, and with his permission we now reproduce three of these tables which were given in the *British Medical Journal*. The general similarity of the curves is remarkable, and it confirms the accepted opinion that zymotic diseases are most prevalent in the winter. Dr. Barnes believes this prevalence obtains all over the world.



Deaths from Scarlatina for all Ages, and both Sexes, Ten Years, 1875-84.



Deaths from Fevers for all Ages, and both Sexes, Ten Years, 1875-84.



Deaths from Erysipelas for all Ages, Ten Years, 1875-84.

The *Saturday Review* some time ago declared that the "vice of inobservance," which has long been common among the upper classes, is now, by reason of our peculiar system of primary education, being extended to the masses. The "penny dreadful" is superseding the book of nature, which many working-men at home and many savages abroad were to some extent capable of reading. We have gleaned not a few interesting observations in natural history and meteorology from illiterate gardeners, gamekeepers, and ploughmen.

We need alike for all classes an education which shall develop the power of observation, and for this end the complete liberation of Science is essential.

MICRO-ORGANISMS IN WATER.

MR. A. WYNTER BLYTH, a public analyst in London, devoted a year's study to the distribution of micro-organisms in the different kinds of water in the vicinity. As the original spores were invisible, he examined the specimens of water after these had been cultivated. This cultivation took place in the germinating gelatine, on glass plates 4 inches by 4 inches. The nutrient gelatine is melted at a gentle heat, and sufficient is poured into an enclosed division on the plate so as to mix with a drop of the water to be examined, and to form a layer of one-tenth of an inch in thickness.

The mixture is then placed in a special chamber where the air is saturated with moisture. After a few days, the colonies developed are counted by the help of a magnifying glass. But to make the counting easier, the glass plate was divided into a number of equal squares by the lateral scratches of a diamond. Mr. Blyth, with the help of Mr. Archer, used an ingenious apparatus for obtaining the water and its suspended particles at any depth. And in the case of sewage the liquid had to be diluted with distilled or sterilised water before being experimented upon, of course the mixing quantities being duly marked. A convenient dilution is one of sewage to a thousand of water. Drops of this diluted sewage, added to the germinating gelatine, yield, after a few days' cultivation, from 100 to 200 colonies. From the calculation of the mixture, it was found by his observation of the colonies in the diluted sewage, that in June the London sewage contained in a drop of the original liquid no less than 160,000 colonies; in July it contained in a drop, three times that quantity; and in November, about half the quantity found in June. This shows that the sewage is considerably influenced by season, containing more in the summer than in the winter season, but for the most part always yielding colonies approaching to or above forty thousand per drop of sewage. These colonies he found to be of all kinds of fungi, more especially aspergilli, bacteria, bacilli, and micrococci.

Mr. Blyth examined several specimens of water, and counted the germinated micro-organisms in a drop of each specimen. A drop of water in a typical pond, which received no drainage, but was frequented by ducks and geese, contained 153 colonies, of which 20 were bacilli and 2 were bacteria of the character *Bacterium termo*. In an open well in Devonshire 400 colonies were found in a drop of water. In the Regent's Canal, in its course through London, he found very bad water, owing to the stagnant character of the canal. A sample, taken a foot below the surface, gave colonies equal to 1,400 per drop, whilst, just above the mud, another sample gave 22,540 colonies per drop.

The water of a stream shows the same fact as in the case of a stagnant pool or canal, that more micro-organisms are near the bottom than near the surface. For instance, Mr. Blyth found that the water of the Thames yielded 500 colonies per drop near the surface, and 2,750 colonies per drop close to the bottom. In the same locality (at Sunbury) Mr. Blyth found in a second sample, which was taken above some black mud, no less than 280,000 colonies per drop. It thus appears that in canals and rivers the bacteria slowly subside.

In the sea-water round the coast of England the very reverse is found as to the distribution of the micro-organisms. In running and stagnant fresh water they are much more numerous near the bottom, but in sea-water they are more numerous near the surface. Samples of sea-water, taken off the old pier at Brighton (in July), were found by him to yield 730 colonies per drop on the surface, and only 10 at the bottom.

Mr. Blyth found that a public water supply, derived from flowing rivers, or from any surface water, varies as to its composition according to season, the more especially as the water has a winter character due chiefly to winter rains, and summer character due chiefly to the summer drought. Month by month he analysed the water supplied to London by the West Middlesex and Grand Junction Companies; and found that the colonies of micro-organisms per drop varied from 7 in May to 45 in July, and down to 3 in November. This is far purer than the water supplied to the city of Berlin, in which 140 micro-organisms are found in the drop in October and 30 in February.

Lake water he found to give a mean for nine months of 20 organisms per drop, the greatest number being observed in March and the lowest number in August.

The conclusions to which Mr. Blyth has come after an extended series of very careful observations are as follows:—Sewage, pond and canal waters contain enormous quantities of micro-organisms up to 180,000 per drop; in canals and rivers the number of these organisms is greater near the bottom than near the surface; in sea water the number of organisms is greater near the surface than near the bottom; and a good water should not contain more than 40 micro-organisms per drop, when cultivated within 24 hours after collection.

CHARACTERISTIC EFFECTS OF DYNAMITE AND GUNPOWDER.

PROFESSOR TAIT has lately pointed out to the members of the Royal Society of Edinburgh the effects of the explosives, dynamite and gunpowder. Many of the victims of the explosion by dynamite in the London Underground Railway, the other year, are reported to have entirely lost the sense of hearing in the side of the head which was next the source of the explosion. This is a curious fact. The result points to a direct projectile motion of the air and of the gases produced by the explosion, instead of the ordinary wave motion. The disturbance must travel far faster than sound; for the ordinary undulatory motion would not so injure the drum of the ear.

This intensely powerful projectile motion is witnessed in the case of forked lightning. Here the air seems to be driven outwards from the track of the discharge with such speed as to render the immediately surrounding air instantaneously self-luminous by compression. Moreover this theory bears out the photographic result which cannot be accounted for by ordinary irradiation. For the forked lightning flash is always photographed as a line of finite breadth, even when the focal length is short and the focal adjustment is perfect.

According to Professor Tait these considerations show at once how to explain the difference between the effects of dynamite and those of gunpowder. The latter is prepared expressly for the purpose of developing its energy gradually, superficially, and in an upward direction. Thus, while the flash of gunpowder fired in the open air is due mainly to combustion of scattered particles, that produced by dynamite is mainly due to impulsive compression of the immediately surrounding air, energy being conveyed to it much faster than it can escape in the form of sound. The energy of the dynamite is not exercised so gradually as with gunpowder; it is sudden, acting in all directions, downwards as well as upwards, defying all the limiting superintendence of the wave phenomena.

EARTHQUAKES.—On the 8th ult. a shock was felt over a great portion of Algeria. On the 12th shocks were felt at Columbia, Charleston, and Summerville, in America.

General Notes.

Whooping Cough.—Dr. Semchenks has confirmed Prof. Afanasieft's discovery of the bacillus of this disease, and has satisfied himself that the bacteria which appear in the sputum about the fourth day are the specific cause of the disease.

St. Elmo's Fire.—During the past four years, eleven cases of this interesting electrical phenomenon have occurred at the Ben Nevis Observatory. The meteorological conditions attending this phenomenon seem to be that the temperature must have been falling for about twenty-four hours, after having been for some time above the mean of the season. The barometer also falls, but recovers itself within three hours of the time of the phenomenon.

Iron Lace Work.—A specimen of lace is being exhibited in New York so light that it can be blown away by a breath, and yet stamped out of a thin sheet of rolled steel. It can be produced at an exceedingly low price. It will be, of course, unfit to come in direct contact with the skin, owing to its relatively high conductive power for heat. Nor do we see how, under such circumstances, it can escape corrosion from the acid of perspiration, even if it can be made proof against the effects of moist air.

The Spectre of the Brocken.—Tourists on the summit of the Brocken have occasionally, in certain states of the atmosphere, and especially at sunrise, seen their own shadows, monstrously magnified, projected upon mists in the valley below. In former ages this phenomenon was regarded, not as a mere shadow, but as a demon—a notion due, possibly, to the very uncanny reputation of the mountain. "S. D. E." writes to the *Scotsman* to the effect that one forenoon last winter, between ten and eleven o'clock, he saw a similar phantom on Arthur's Seat, Edinburgh. We once witnessed it a long time ago on the summit of the Milleschauer, in Bohemia.

Postal Telegraphs.—According to Mr. Graves, the newly-elected President of the Society of Telegraph Engineers and Electricians, the English Post Office employs in telegraphic operations 18,303 persons. In connection with British land telegraphs, including those connected with railways, there are engaged 23,900 persons; in submarine telegraphs (chiefly British), 6,000; in British telephone companies, 2,500; in British electric lighting, 5,000; and in British cable-making and and allied businesses, 5,000. If we add those persons engaged in trades into which electric operations enter, we shall find that in these realms alone there are 100,000 persons directly depending for their employment on the applications of electricity.

Black Rain.—Recently a shower of black rain fell at Castlecomer, in Ireland, and on the same day a smaller shower fell at Newport, in Monmouthshire. It was accompanied by partial darkness, making it necessary to light the lamps and candles. It left a black deposit where it fell. Newport is a town of 40,000 inhabitants, and contains various manufactories. A dark, heavy cloud lay over the town in the afternoon. It should also be mentioned that coal is worked in the Castlecomer district. The shower there happened a few hours later than at Newport. Recent researches have shown that electricity condenses smoke in air, and there was thunder at Newport. It is possible, therefore, that the smoke condensed by electricity was brought down by the rainfall.

The Serration of Leaves. — Professor Rudolph in a series of lectures on "The Great Wonders Around Us," propounds a theory of the functions of the finely serrated edges of certain leaves. He considers that these points and edges serve to permit the escape of electricity, which might otherwise accumulate on the surface of the earth in dangerous quantities, and give rise to *ascending* lightning-strokes. The very same points and edges quietly convey away the electricity from the atmosphere, and thus to a great extent disarm the tempests. Professor Rudolph asserts that the highest trees, such as pines, have the most pointed leaves.

Electro-Removal of Barnacles. — At a recent meeting of the Royal United Service Institution, Mr. C. F. Henwood expressed the opinion that, if zinc-sheathing were applied so as to be in contact with the electro-negative iron or steel, an electric or galvanic relation would be established. The zinc would be perpetually dissolving away and carrying with it the barnacles and other zoophytes, thus leaving a clean surface. He considered that iron or steel ships, so sheathed with zinc, might navigate the seas practically as free from fouling as our old copper-sheathed wooden ships. We are somewhat sceptical as to the practical working of such a system, but apart from this there can be no doubt that the expense of resheathing with zinc would be very considerable—probably greater than that of cleaning off the barnacles.

The Origin of Petroleum.—Professor Mendelejeff has advanced the theory that petroleum is of mineral origin, and that its production is going on, and may continue almost indefinitely. He has succeeded in making it artificially by a similar process to that which he believes is going on in the earth, and experts find it impossible to distinguish between the natural and the manufactured article. His hypothesis is that water finds its way below the crust of the earth and there meets with carbides of metals, particularly of iron, in a glowing state. The water is decomposed into its constituent gases; the oxygen unites with the iron, while the hydrogen takes up the carbon, and ascends into a higher region, where part of it is condensed into mineral oil, and part remains as natural gas, to escape where it can find an outlet, or to remain stored at great pressure until a borehole is put down to provide it a passage to the surface.

Periodical Swarms of Shooting Stars.—M. Ch. V. Zenger, in a memoir presented to the Academy of Sciences at Paris, points out that the days of the November swarm (November 6th to 9th and 11th to 15th) were marked by magnetic, electric, and atmospheric perturbations, earthquakes, outbursts of gases and eruptions of subterranean waters, as well as by the fall of meteorites. On the 7th, a fire-ball of the second magnitude was observed at Vienna, and a considerable fall of the barometer. On the 8th and 9th, a severe earthquake at Venice and Ferrara, and a great tempest on the coast of Picardy,

On the 9th, a severe earthquake shock at Forli and Imola. On the 11th, great fall of barometer at Prague and storms in Istria. On the 12th, the inundation of the Hoang-Ho, heavy snow-storms in mountains of Austria, Italy, and Switzerland. On the 14th, earthquakes at Florence, on the Durance, and at Klagenfurt; the same day, fearful explosions of fire-damp in the mines of Dortmund, and a strong magnetic perturbation in Styria. On the 15th, shipwrecks in the Adriatic.

THE OCCURRENCE OF ARSENIC IN HUMAN REMAINS.—With reference to certain recent events, the following facts, taken from the *Chemiker Zeitung*, are not unimportant:—"In districts where arsenic-eating is practised the new-born children of women who take arsenic are distinctly larger than children whose mothers do not indulge in this habit. If a woman has produced children, and afterwards becomes an arsenic-eater, her subsequent children are larger than the former, and grow more rapidly during the first months of life. Children whose bones have not yet ceased growing, if they receive small and frequently-repeated doses of arsenic, grow with unusual rapidity, and generally attain an exceptional stature. Hence we may conclude that the children of arsenic-eaters owe their rapid growth to small quantities of arsenic derived from the blood of the mother, and conveyed through the placenta or the milk. Traces of arsenic may be and have been found in human remains without arsenical poisoning and without any impurity in the reagents. Arsenic is sometimes found in potatoes, in turnips, and in the exterior leaves of cabbage. Copper occurs in wheat and in the livers of swine and oxen.

GEOLOGICAL DISCOVERY.—The Elgin sandstone, so unique and so prolific in the domain of palæontology, has just yielded two more fossils, one of which, if possible, deepens the mystery which hangs around this formation. This discovery was made at Cutties Hillock quarry, the spot which was the immediate cause of the great discussion at the meeting of the British Association at Aberdeen in 1885. Since then a number of specimens have been found which have aroused the keenest interest among scientific men. Hitherto the upper beds have yielded purely reptilian remains, the most remarkable of which has been Dicynodon, a fossil which, as far as is yet known has been found only in African strata. One of the fossils just discovered appears to be another specimen of that creature, but until parts of the sandstone are cleared away, which at present hide considerable portions of the remains, it would be impossible definitely to say what the fossil is. The other is more extraordinary, and may turn out to be as rare in the British Islands as Dicynodon. Had it occurred in a different horizon or in strata admitted by all to be of old red age, what appears to be a large fish plate would have been without much hesitation described as belonging to Pterichthys. As it is, those most opposed to the theory that the upper beds are of Triassic age would scarcely dare to expect to find the remains of so characteristic an old red fish associated with reptilian remains. Whatever the fossil may turn out to be, it is a fresh link in the wonderful chain of palæontological evidence which the Elgin sandstones have afforded and which enrich the museums of London, Edinburgh, and Elgin.—*Times.*

HOMŒOPATHIC MEDICINES.—In connection with the controversy now raging in the columns of the *Times* on the relative merits of Allopathy and Homœopathy, Dr. Dupré gives the following analyses of some homœopathic pills he examined some years ago:—

Sulphate of copper pilules, second dil.—First sample—No copper could be detected in 100 pilules. Second sample—No copper could be detected in 200 pilules. If in the second case as little as 1-2,000,000th of a grain of sulphate of copper per pilule had been present it would have been detected.

Corrosive sublimate pilules, second dil.—Two samples.—It was just possible to detect mercury when 200 pilules were taken for analysis. Less than 1-400,000th part of a grain of corrosive sublimate per pilule was present.

Nux vomica pilules, second dil.—No strychnine could be detected, even when 300 pilules were taken.

Belladonna pilules, second dil.—No atropine could be detected in 300 pilules. If as little as 1-2,000,000th of a grain per pilule of either strychnine or atropine had been present it would have been detected.

Aconitum napellus pilules, first dil.—First sample—No aconite could be detected in 100 pilules. Second sample—No aconite could be detected in 100 pilules. If as little as 1-800,000th part of a grain of aconite per pilule had been present it would have been detected.

Belladonna pilules, first dil.—First sample—No atropine could be detected in 100 pilules by chemical means. Second sample—No atropine could be detected in 100 pilules by chemical means. If as little as 1-600,000th part of a grain of atropine per pilule had been present it would have been detected.

THE MANUFACTURE OF ALUMINIUM.—Works for the manufacture of sodium by the Castner process, and the production of aluminium under the process of Mr. James Webster, are now being erected by the Aluminium Company, at Oldbury, near Birmingham, which, it is expected, will bring an important trade to the district. By the Castner process the cost of sodium is reduced from 4s. to 1s. per lb., and of aluminium from 60s. to less than 20s. per lb. The aluminium is produced in pigs of 4 lb. weight. The same-sized pig of the alloy known as aluminium bronze, copper and aluminium, weighs 12 lb., a fact which strongly illustrates the relative lightness of aluminium. Its value is further increased by its tensile strength and its non-liability to oxidise. It is obvious that the manufacture of this reliable metal upon an extensive commercial scale, and at much lower cost than hitherto, involve important consequences to English metallurgical industry. Its employment must at once be greatly extended. The new works at Oldbury occupy $4\frac{1}{2}$ acres of ground, and they will be capable of producing £300 worth of aluminium per day. The number of men to be employed is not yet definitely decided upon, and in aluminium manufacture extent of production is indicated more by the amount of machinery and plant than the number of workmen engaged. At Oldbury there will be four furnaces, each with five chambers, for the manufacture of sodium, and a number of other furnaces which have yet to be erected will be used for making chloride of aluminium and the aluminium itself. At the Solihull works of the company aluminium alloy is already being turned out, and is being received with considerable favour. Many metal-working firms are using an alloy of aluminium and copper—90 per cent. of the latter to 10 per cent. of the former—and express much satisfaction with its qualities.—*Iron.*

WILL MEN EVER FLY?—III.

(*Concluded from p. 82.*)

BETWEEN the structure of the bird and that of the insect we cannot but expect to find many important differences. The one is a vertebrate animal, the other an invertebrate. The one breathes by means of lungs, the other by means of air tubes which permeate the whole of the body. The one possesses a brain and a heart, the other possesses neither. And thus the frames of the two beings are radically distinct in character, and comparison between them, excepting as regards the broad principles involved, is altogether impossible.

These principles, however, are absolutely identical in both cases. The strength of muscle and rigidity of muscle-attachment, the provision of an increased air-supply, and the removal of every unnecessary particle of material, are requirements as carefully fulfilled in the insect as in the bird. Again, we find power of flight the one paramount necessity, and all else subservient to it. Again, we find every detail of the structure modified in accordance with the special functions required. And in the insect, just as in the bat and the bird, we notice that total dissimilarity to all allied groups which is the best possible evidence of man's utter impotence, future as well as present, to traverse the realms of air.

Upon the wings of insects we need not dwell, for the reason already given in the case of the bat—namely, that in man, could he ever sufficiently overcome his physical disabilities for aerial locomotion, their place would be taken by artificial substitutes. Upon their motive power, however, a few words are necessary.

For, contrary to what we might reasonably infer from analogy, the muscles of flight do not operate upon the wings themselves at all, but upon the thorax, from the sides of which they proceed. In the words of Mr. B. T. Lowne, "the wings are so attached that the flank forms a kind of fulcrum, upon which they are elevated or depressed by every alteration in the convexity of the back. The great longitudinal dorsal muscles, by shortening the thorax, increase its convexity and depress the wings, which are again elevated by the flattening of the back and lengthening of the thorax, due partly to its own elasticity and partly to the action of the lateral thoracic muscles, which are verticle in their direction."

Whatever the mode of their action, however, the strength of these muscles must naturally be very great, seeing that flight must sometimes be continuously maintained for several successive hours (as in the case of the dragon-fly), and that the motion of the wings meanwhile must be almost incredibly rapid. And the greater portion of the interior of the thorax is, in fact, occupied by the flight muscles. Bones, of course, being altogether wanting, these vessels are attached to the inner surface of the skin itself, which, firm and leathery as it is, forms, in fact, a kind of external skeleton, as well as a complete suit of natural armour.

The two requirements of air-supply and lightness of frame in the insect go together; and few things in the entire range of comparative anatomy are more striking

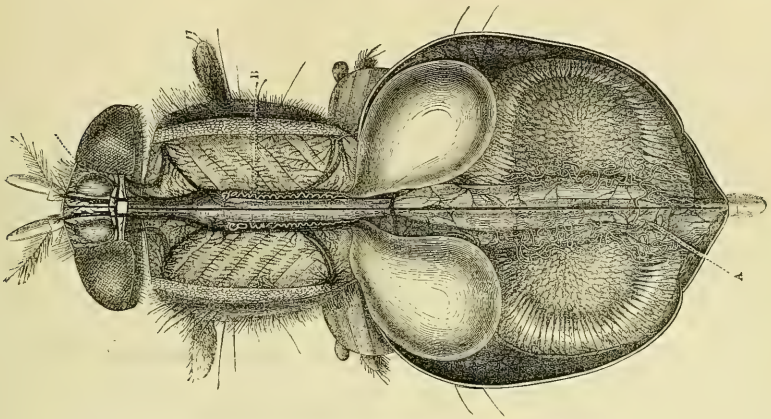


FIG. 3.—BREATHING ORGANS OF AN INSECT.

than the manner in which almost all the necessary modifications of structure are made to serve a double purpose.

A very important illustration of this fact we find in the character of the respiratory system.

As already stated, insects possess no lungs, the place of which is taken by a series of breathing-tubes permeating the whole of the body. Briefly described, these tubes are found in the form, firstly, of a parent-trunk (A, B, in fig. 3), so to speak, running along either side of the body, and communicating with a number of spiracles, or breathing-holes, which are generally situated at intervals upon the median line; secondly, of a number of branches and sub-branches proceeding from these main-tubes, which ramify, and ramify, and ramify again, until every part of the body is traversed by them, even to the antennæ and the claws.

Now, these tubes, besides permitting a most complete and incessant aeration of the blood, manifestly reduce the bodily weight very considerably indeed. In the first place, they obviate the necessity for localised lungs, which are somewhat weighty organs; in the second, they purify

the blood far more thoroughly and effectually. And this for the following reason. Lungs, in their specified form, can only aerate a small proportion of the blood at each inspiration; the respiratory system of the insect, on the contrary, simultaneously purifies the whole, without the need of first conveying it to a definite centre. Thus an insect has none of what we generally term venous blood, or that which, having run its course through the arteries, has been deprived of its life-giving particles, and clogged with impure matter which must be thrown off in the lungs before it can again be fit for use; and the venous blood amounts to one-half of the whole. Consequently, an insect need possess *only half the amount of blood which it would otherwise require;* and a considerable amount of weight is again dispensed with. This perfect aeration of the blood it is that gives to an insect its bright and vivid life, its tireless energy, and the quick vivacity of movement which renders it, proportionately speaking, infinitely superior in speed and agility to any other living being. And this it is which renders it a creature of flight, in the most perfect acceptation of the term.

With minor details of structure, as in the case of the bat and the bird, we need not concern ourselves. Enough has been shown to prove that the power of flight, so far from being a mere faculty dependent upon the possession of wings, is the outcome of a most elaborate series of bodily modifications, prompted, in the first place, by the three essential requirements of great muscular power, increased air-supply, and utmost possible lightness of frame; and, in the second, by the consequent alterations which cannot but follow upon the first; for a change of structure, great or small, inevitably brings others in its train. If the bones are altered, the muscles must be altered too; if the muscles are altered, the nerves must be altered; and so on. And so radical a change as that brought about by the possession of the power of flight cannot but influence, directly or indirectly, even the remotest and most insignificant portions of the frame.

Now, man is as little suited to flight as almost any being upon the face of the earth. Relatively speaking, he of all creatures is one of the least muscular. To work wings of the size which he would require, with the rapidity necessary to their successful employment, would be altogether beyond his powers, while, even were their motion to be rendered automatic, the character of his bodily balance would still render flight impossible.

For, as has already been pointed out, the natural attitude of all flying animals is horizontal; that of man is perpendicular. To pass through any resisting medium—air, earth, or water—the form must be more or less conico-cylindrical. Birds are so; insects are so; moles and earth-worms are so; fishes are so. And man is not.

So our hopes of flight, if such hopes we may justly entertain at all, must be based not upon the ingenuity of cunning artificers who shall devise wings to bear us aloft in air, but upon the progress of mechanical science, which, by discoveries as yet undreamt of, may conquer the difficulties of aerial locomotion, and enable us to rise aloft by means of machines whose power of ascension shall not be a mere question of specific gravity. Possibly such machines, if ever they should be invented, may be adapted to the individual, who thus would acquire all the conveniences accompanying the power of flight, and yet would be independent of his own physical exertions. Such may, or may not, be one of the inventions of which man will be able to avail himself in future ages. But as to the possibility of his acquiring the power of actual flight there can be no question at all. Nature has long since answered that inquiry in the negative. Flight, as we have seen, is much more than a mere faculty dependent upon the presence of wings; it is possible only to those beings whose entire organisation has been moulded in accordance with the special requirements following upon its possession. And as man is not one of those beings, and as his physical conformation is a matter wholly beyond his own control, we may dismiss at once and for ever the notion that under any circumstances or at any time he will be able to acquire the enviable faculty of flight.

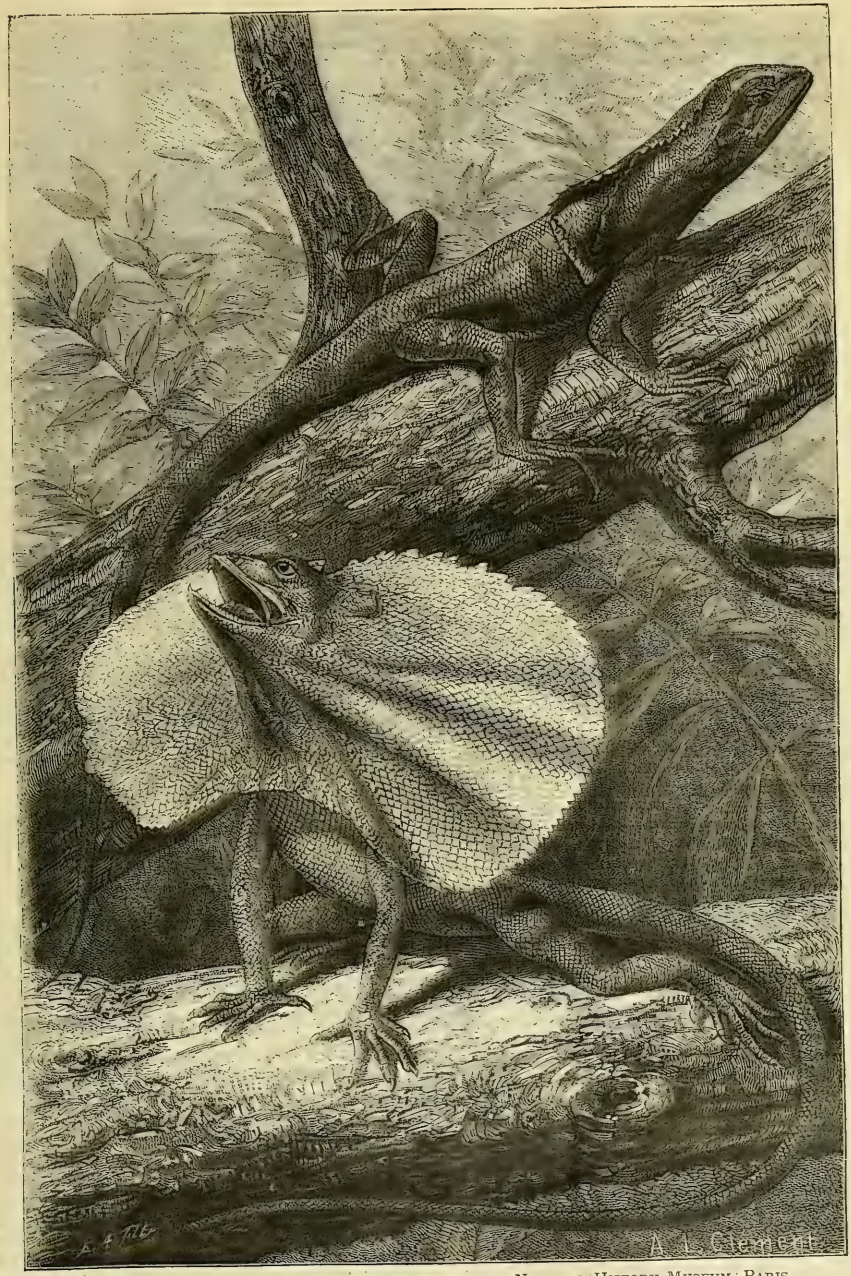
Natural History.

KING'S *CHLAMYDOSAURUS.*

An Australian lizard, which had hitherto not been brought over alive, arrived a short time ago at the menagerie of the Natural History Museum in Paris, but unfortunately only survived for three weeks.

This lizard was remarkable, as it had on the sides of the neck a large projecting membrane jagged at its edge, and folded upon itself after the manner of a fan. When in a state of repose it was applied close to the neck, around which it formed a kind of collarette. This strange lizard is King's Chlamydosaurus (*Chlamydosaurus Kingii*, Gray). The two halves of the collarette were continuous under the throat, but separated behind, where they slightly overlapped. Each consisted of a fold of skin covered with large carinate scales, and sustained on each side by a subcutaneous thickening having the appearance of cartilage, as well as by a bony process springing from the hyoid bone. Special muscles moved this apparatus, enabling the animal to erect or fold it at will. We do not think, however, that it can be unfolded to its fullest extent, as the number of supports appeared to be insufficient, and the observations made while the creature was in captivity confirmed this view. The lizard now and then raised this appendage when attempts were made to catch it, but only very incompletely.

At present the exact use of this collarette is not known, but as it is of the same character as the membranes on the sides of the bodies of other Lacertians, such as the "flying dragons," or of certain mammals, as, for example, bats, "flying foxes," etc., it is probable that they are employed for a similar purpose and that they constitute an accessory means of locomotion. According to *La Nature*, from which we borrow the accompanying illustration, this lizard lives in trees, the one under observation being constantly perched, and it is probable that when it jumps from one branch to another it erects this membrane, which thus serves as a kind of parachute. On the other hand, as it feeds mainly upon insects, and perhaps catches them in their flight by throwing itself upon them, it may use this appendage to increase and regulate its bounds. Much stronger and more elegant than the ocellated lizard, the Chlamydosaurus may attain a length of about 31 inches from the snout to the tip of its very long tail. Its limbs are strong, and its claws curved and sharp-edged, as is necessary for a climbing animal. It is agile and abrupt in its movements. When resting it leans upon its tail, and raising itself on its fore-paws erects its head, which



THE CHLAMYDOSAURUS IN THE REPTILE HOUSE OF THE NATURAL HISTORY MUSEUM, PARIS.

it holds quite motionless, as though it was taking an observation.

It seems to be quite harmless, and has never attempted to bite when endeavours have been made to catch it.

It is of a dark colour, pale brown on the back, lighter underneath, with irregular darker patches upon the back and limbs, and with nearly black rings round the tail. The teeth of the collarette are white at the edges, and seen from a distance appear like two rows of pearls.

The Chlamydosaurus belongs to the family of the Agamidæ, which possesses a few representatives in Europe and none in America. This is the only known species of the genus, and has only been found in Australia and some adjacent islands to the north.

The Senses of Animals.—Sir John Lubbock lectured on the 19th ult. at the Catford Hill Literary Society on the Senses of Animals. He gave reasons for thinking that in other animals the range of sound was different from that of man, and that they could hear higher notes. He had proved that the limits of vision in animals extended beyond ours. He then showed that animals possessed sense organs, of the use of which we were as yet entirely ignorant, and he suggested that these might be the seats of unknown senses. At any rate they could certainly hear sounds which were inaudible to us, and see light which was beyond the range of our eyes. These considerations raised the reflection how different the world must appear to other animals from what it did to us. Sound was the sensation produced on us when the vibrations of the air struck on the drum of our ear; when they were few the sound was deep; as they increased in number it became shriller, but when they approached 40,000 in a second they ceased to be audible. Light was the effect produced on us when waves of light struck on the eye. When 400 millions of millions of vibrations struck the retina in a second they produced the sensation of red, and as the number increased the colour passed into orange, then yellow, green, blue, and violet. But between 40,000 vibrations in a second and 400 millions of millions we had no organ of sense capable of receiving the impression. Yet between these limits any number of sensations might exist. We had five senses and sometimes fancied that no others were possible. But it was obvious that we could not measure the infinite by our own narrow limitations. Moreover, looking at the question from another side, we found in other animals complex organs of sense richly supplied with nerves, the functions of which organs we were as yet powerless to explain. There might be several other senses as different from ours as sound was from sight; and even within the boundaries of our own senses there might be endless sounds which we could not hear, and colours as different as red from green of which we had no conception. These and a thousand other questions remained for solution. The familiar world which surrounds us might be a totally different place to other animals; to them it might be full of music which we could not hear, of colour which we could not see, of sensations which we could not conceive. Here was a wide and as yet almost untrodden field of study. To place stuffed birds and beasts in glass cases, to arrange insects in cabinets, and dried plants in drawers, though most important, was merely the drudgery and preliminary of study; on the other hand to watch their habits, to understand their relations to one another, to study their instincts and intelligence, to ascertain their adaptations and their relations to the forces of nature, to realise what the world appeared to them, was the true interest of natural history, and might even give us the clue to senses and perceptions of which at present we had no conceptions.

Trebizonde Honey.—Mr. H. J. Ross, in the *Gardener's Chronicle*, thus speaks of the poisonous nature of Trebizonde honey: "Having resided at Trebizonde, the scene of the poisoning by honey of Xenophon's soldiers, I can say that the chief undergrowth of that part of the southern shore of the Euxine, or Black Sea, consists now of *Rhododendron ponticum* and *Azalea pontica*, whereas no oleander grows on any part of that coast. The rhododendron has little or no scent, whereas the azalea has a powerful and sweet odour. The flowers precede the leaves, and in spring whole hill-sides present sheets of golden yellow, and the country is perfumed for miles round. The opinion of the natives is that the poisonous honey called in Turkish '*Delli kal*,' or mad honey, is derived from those highly-scented flowers of the azalea. The honey has a very peculiar, and to most people disagreeable, taste in its crude state, and when eaten produces vertigo, sickness, purging, and great prostration. After many hours the effects pass off, and the sufferers gradually recover. The honey, nevertheless, is much used in cookery, confectionery, and for preserving fruits, being much cheaper than sugar; but previous to use, it is cooked on the fire, and the heat volatilises the poisonous principle, when it can be eaten in safety. Whether the rhododendron is also poisonous, I do not know; many think it is, and such was evidently the opinion of Xenophon."

Larvæ Dangerous to Men and Cattle.—M. Portchinski has recognised *Sarcophila wohlfahrti* as a dangerous enemy of man and other animals, which it destroys by introducing its eggs into their nostrils in the same manner as the "screw-worm" of America, *Lucilia humanivora*.

Insects and Dead Animals.—According to M. P. Megnin the worms which devour buried animals are not earth-worms, but the larvæ of four dipterous species and one coleopterous insect. The latter seems to feed on the fat of the inhumed body.

Thames Otters.—On Sunday the 22nd ult. Charles Hone, fisherman, Staines, succeeded in capturing alive a fine male otter weighing about 27 lbs. It was taken in a trap on the Surrey side of the Thames, and the work of transferring the animal from the trap to a box was attended with considerable difficulty. Hone recently lost two others, one of which got away minus portions of its fore feet. An effort is being made to secure these and also others known to exist at Penton Hook and Sunbury.

An Open Aviary.—The Rev. C. S. Millard, writing in the *Selborne Magazine*, gives a pleasing account of his "open aviary," the inmates of which, as soon as they can be trusted, are allowed to fly out and return at pleasure. The colony consists at present of four bullfinches, two of them hatched in the aviary, two black-headed buntings, a yellow-hammer, and two redpoles. The yellow-hammer is particularly useful to farmers, as it feeds by preference upon the destructive crane-fly.

THE BURSTING OF LEADEN PIPES BY FROST.

ON questioning plumbers as to the cause and time of pipes bursting during frost, we find the general impression to be that the pipe only burst after a thaw had set in, and was caused by the ice in the pipe melting, and the pressure thus becoming too great for the strength of the metal. Messrs. Bruce and Thomson, Glasgow, have for the past three winters been making experiments on the subject, which they have communicated to the Philosophical Society of Glasgow. They have been able to refute the time-honoured idea.

But before proceeding to give the results of their inquiry, it will be necessary to mention a few preliminary considerations in reference to water and lead. Pure water freezes at 32° Fahr., but it possesses the property of remaining liquid at a temperature as low as −11° Fahr., provided that it be kept still, and that sufficient pressure is maintained to prevent its expansion. If water be enclosed at 39° Fahr. in a cast-steel tube, thick enough to be regarded as inextensible, it will remain liquid for days at −11° Fahr., as shown by the mobility of a steel ball enclosed in the tube. But when this tube is opened, and the water allowed to expand, solidification takes place. At this point of 39° Fahr. water reaches its greatest density, and it expands with the decrease and increase of the temperature from this point. Water in the act of freezing expands by fully 10 per cent.; this is an important fact, one cubic foot expanding into 176 cubic inches more. Besides, the compressibility of water is very slight, one atmosphere (about 15lbs. on the square inch) reducing its volume to the extent of only one-twenty thousandth.

Of the lead used in commerce the English is the purest, and the Spanish the most impure, the former containing 99¼ per cent. of lead, and the latter 95¾—a very hard lead. The presence of antimony, zinc, copper, and tin affects the ductility and malleability very much. Lead has a very low tenacity; its tensile strength varies from 1,400lbs. per square inch to 3,300lbs. Impurities reduce specific gravity, and have the tendency to make the lead harder, while increasing the tensile strength generally, which in pipes is rather an advantage than otherwise, if not carried to excess.

Let us now consider a case of bursting of the pipes by frost. A pipe is led in from the street, taking a sharp turn inside the wall in its course to the floors above. A column of ice forms in this pipe, and owing to the bend the ice cannot move. Practically a plug has been formed, so that the water in the pipe higher up between the ice and the tap is subjected to considerable pressure, which increases as the congelation continues in the pipe, until the pressure becomes so great that the strength of the metal is overcome, and a rent takes place. At the moment of release, by the pipe giving way, the remaining quantity of water immediately freezes; and until the temperature rises above the freezing point it gives no inconvenience as regards flooding the premises. In fact, the pipe may be rent for days before being detected after the rise of temperature, called thawing.

Now considering the facts regarding water previously mentioned, this is just what might be expected; for it is self-evident that if water at its greatest density be enclosed in a lead pipe and securely plugged at both ends, and the ends be placed in a freezing mixture, so that ice is formed there, then, as the formation of ice proceeds from each end, the water in the middle will increase in pressure, with the result that the pipe is bulged out in the centre, and ultimately bursts. But the question arises, At what pressure do these pipes burst? On account of the difference of opinion on the tensile strength of lead, no accurate answer can be got by considering that property. Pipes commonly used by water companies are not selected according to their strength or quality, but according to their weight per linear yard—pipes ½ inch diameter being 7lbs. per linear yard; ¾ inch, 10lbs.; 1 inch, 14lb.; 1¼ inch, 18lbs.; and 1½ inch, 24lbs. The bursting pressures per square inch of these pipes are successively 1,820lbs., 1,232lbs., 1,091lbs., 1,036lbs., and 812lbs., although the thickness of the lead in the last pipe is one-tenth more than in the first pipe. From this it is evident that the strength of the pipes is by no means on an equality, for the smallest pipe stands more than twice the amount of pressure that the largest pipe can bear before bursting. This may be accounted for by the fact that the smallest pipes are not made of so pure lead as the largest, the tensile strength of the tin mixed with it being double that of lead, and of the solder mixed with it being about four times that of lead.

Mr. Jardine has found, after a series of interesting experiments, that a 1½-inch pipe $\frac{1}{10}$-inch thick stood 1,000 feet head of water without alteration; at 1,200 feet head it began to swell; enlarged to 1¾ inch diameter at 1,400 feet head it burst, giving a bursting pressure of 606lbs. and 2,611lbs. of tensile strength. On the other hand, a 2-inch pipe $\frac{1}{10}$-inch thick stood 800 feet head without alteration; but at 1,000 feet head it burst, giving 433lbs. bursting pressure and 2,412lbs. tensile strength. Box, in his "Strength of Materials," gives the safe working pressure, without any shocks, at one-tenth of the bursting pressure, and, with shocks, at one-twentieth of the strain.

Now what causes the shocks so often heard in the water-pipes? The sudden closing of a tap. This well-known knocking or hammering sound is scarcely avoidable in the ordinary water supply service of towns; but if a screw-down tap or a ball-cock is used, the flow of water is stopped gradually, and the noise is removed. It may be the case that this is the reason why the smaller pipes are made so much stronger in proportion; but it would not hold good in the case of a number of small pipes and short lengths taken from a large pipe. In this case the large pipe would be too weak to stand the repetition of a sudden shock of two or three taps being closed suddenly at the same time. Another reason for the smaller pipes being so much heavier may be on account of the numerous bends to which they are subjected when being fitted up in houses, and which, in the case of the larger sizes, are not of so frequent occurrence.

When the bursting orifices of different pipes are carefully examined, a marked difference is observable between the forms when the pipes are burst by water without frost and with frost. Pipes burst by water pressure, without the intervention of frost, have a break showing a long, narrow slit, just sufficient to ease off the pressure; while those burst by the action of frost have the lips of the orifice forced out to varying widths. This is caused by the solid ice being forced out by the expansion of the water at the moment of freezing. In this way the character of the break might be used as a test for the quality of the metal of which the pipe is made.

The question might be asked as to what length of pipe would require to be frozen to produce sufficient pressure

to burst the pipe. According to Mr. Thomson's experiments for a pipe $\frac{3}{4}$ inch diameter it would require a length of about seven inches to produce the burst by the expansion of the water in the act of freezing. This would only be sufficient to burst the pipe, but would not force it open to the extent generally found after a thaw. The surplus water freezing at the instant of release, and being forced out in the expansion, would form a solid lump of ice on the outside of the pipe, not a drop of water being lost in the process of changing form. This must have been frequently noticed. When a pipe, cylinder, or other vessel has been burst by the frost, the ice has been seen projecting out several inches from the surface. This is another instance of the flow of solid bodies, and is to be seen in perfection among the Alpine glaciers, when the molecules give way and accommodate themselves to the ground over which they pass.

THE LINEFF ELECTRICAL TRAMWAY

THE various systems of electrical traction that have been proposed up to the present may be divided into conductor and battery systems. Secondary batteries or accumulators are being gradually improved, and though still made principally of lead, they will probably be used for propelling carriages on long lines. The conductor systems, however, present several important advantages, especially for lines a few miles long, and any difficulties that are likely to occur will be mechanical, and can to a considerable extent be provided for by careful design.

Three systems of conductors have been proposed, one being the overhead, which was used at the Paris Electric Exhibition of 1881, where bare wires were hung on poles by the side of the line, and a running collector attached to the car by an insulated cable, travelled along them. It appeared at first that no modification of such a system would enable the branching of a line to be provided for, but in the recent paper by Dr. E. Hopkinson, read at the Institution of Civil Engineers, it was suggested that the wires might hang directly over the car, and being left rather slack, they would make contact with a bar on the top of the car. This useful paper forms a landmark in the literature of the subject, although it deals with a railway rather than a tramway. The method there referred to has been adopted with marked success at the points where the Bessbrook electric railway crosses the public roads. A continuous contact is provided by arranging a contact bar at each end of the car, so that one span of wire touches the foremost bar, before the connection has been broken at the rear. Such a system is not admissible in a town which has any regard for appearances, but seems well adapted to suburban traffic.

The Bessbrook line has a surface conductor, which consists of an inverted channel of rolled steel, mounted on prepared wooden supports, the return current flowing through the rails. The highly successful electric railway at Brighton is not provided with a separate conductor, the current merely passing from one rail to the other, and the wheels being insulated from each other. Such a method will only suffice for very short distances. The method which has recommended itself to many engineers as the most mechanical and trustworthy for use in townis the channel system, in which the conductor is carried out of sight, and if possible out of reach, in a channel or slit tube beneath the level of the road. An electrical tramway has been at work at Blackpool for some time, in which the channel system is employed. It cannot, however, be said to be an entire success, although the length is only a few miles, and the gradients are imperceptible. The chief causes of difficulties have been in insulating the conductor from the earth. On short lines of a mile or so the insulation presents little difficulty, for a fairly large current can be used at low pressure. But when the line is several miles in length there would be a serious loss if the electricity were not supplied in a small current at a high pressure. For high pressure, high insulation is necessary. Several highly ingenious methods have been proposed for working a number of cars in series—that is, the same current is made to flow through each in succession; but the details are too complicated to be discussed here. There is a great field for comparatively short lines, and the latest system, if not presenting any remarkably new departure, presents several well-designed features. We refer to the Lineff Electrical Tramway, of which a public trial was made a few days ago at the *depot* of the West Metropolitan Tramway Company. About 80 yards of line have been laid down, and an extension, including a passing place with points, was in process of construction. There is a conduit or channel between the rails, having an opening of three-quarters of an inch on a level with the ground. The channel is of concrete, about 6 inches thick, rendered with cement, and a cast-iron chair at every two or three feet presents a flush surface to the inside of the conduit. The conductor is a bare copper wire in a gas pipe, which acts as a conductor also, the wire serving to increase the conductivity, and to ensure continuity. At intervals of three feet six inches, iron crutches presenting a side view similar to the rowlock of a boat, are screwed into the iron pipe. These are the contact pieces, and are placed on one side of the centre of the channel, so that they are not visible from outside and are not within direct reach of rain and dirt, though they might be got at by a boy of an inquisitive turn of mind, by means of an iron hoop. The collector on the car is a wire rope running nearly its whole length, and with sufficient slack to allow it to touch at least two of the contact pieces at the time. The rope is covered with short lengths of brass tube, with the view, we presume, of providing for wear. This method of collecting offers great facilities for taking the points when the line branches. The attachments of the collecting rope to the car, are strong, flat bars, which are arranged to wedge up any stones that may be jammed in the groove. The car was driven by an Immisch motor series-wound, running at 1,000 revolutions when the car travels at eight miles an hour.

A rather rough regulator was arranged to control the circuit when the current was switched on and off. The car took about 10 amperes of current at a pressure of 230 volts to run it at six to eight miles per hour. This is equivalent to $4\frac{1}{4}$ horse-power, which is more than we expected, considering the motor and the chain-gearing used. The car is provided with a hinged board at either end, which, on meeting with an obstacle, makes a contact which puts on an electric break, and at the same time reverses the motor. In an experiment to test this, the car, running at about six miles an hour, with half a dozen passengers, was stopped by a box filled with sand, in about 2 ft., the box being pushed that distance, and the car retiring from it at about three miles an hour after the reversal.

Reviews.

Lectures on Electricity. By George Forbes, F.R.S. London: Longmans, Green and Co., 1888.

We have here six lectures, of which five were in substance given before the Society of Arts; the sixth, on Dynamo-electric Machinery, was delivered at the Electrical Exhibition at Philadelphia in 1884 at the request of the Franklin Institute. They are intended to convey to people of ordinary education a knowledge of the fundamental facts and principles of electricity, and to enable them to appreciate intelligently its many applications. Very admirably do they fulfil this intention, and by bringing the science of electricity in its main features within the grasp of those who are not professedly "scientific," they form valuable aids to general culture. Mr. John Morley says that "the number of sorts of knowledge in which a man feels at home, and is intelligently cognisant of their scope and issues, even if he be wholly incompetent to assist in the progress of discovery, increases that intellectual confidence and self-respect of understanding which so fortifies and stimulates him in his own special order of work;" and Mr. Forbes has, in the course of lectures before us discussed the subjects of potential and electro-motive force, electric current and resistance, magnetism and electro-magnetism, in such a way as to render possible their inclusion within the list of "sorts of knowledge in which a man feels at home" if he will but take the little trouble involved in reading them and thinking about them.

Journal of Microscopy and Natural Science, and the Journal of the Postal Microscopical Society. Edited by Alfred Allen. London: Bailliere, Tindall and Cox.

In this valuable journal especial attention is due to the inaugural address of the newly elected President, the Hon. J. G. P. Vereker. In it especial attention is being drawn to the especially dense glass manufactured by Messrs. Schott and Co., and to the lenses known as apochromatic objectives made from it by Zeiss and Co., of Jena. The speaker considered that this glass is a new weapon by which we can force nature to surrender more of her secrets. We can only object to the expression "The Science of Microscopy." Microscopy is a method of research of great and unexhausted value in biology, geology, mineralogy, chemistry, even to some extent in physics. But we cannot call it a "science," unless we cease classifying the various disciplines according to the orders of phenomena concerned.

Mr. J. W. Gifford communicates a short but useful paper on "Apochromatic Objectives."

A paper on the "Hessian Fly," by a writer using the *nom de plume* "Entomologist," has been borrowed from the *Journal of Horticulture*. The writer considers that the original home of this pest is in America, but that it has been introduced into England from the European Continent in straw.

Mrs. Alice Bodington communicates a most instructive paper on "Micro-organisms as Parasites." Her account of the conflict taking place in the blood between the leucocytes (colourless blood-cells) and the invading disease-germs is graphic without being over-drawn.

The "Development and Life-History of the Tadpole," from the pen of Mr. J. W. Gatehouse, is a highly interesting study.

"The Microscope and How to Use it," by J. A. Laltham, F.R.M.S., contains a collection of useful recipes for cements and other compositions used in mounting preparations.

"Half an Hour at the Microscope," by Tuffen West, F.L.S., is a collection of instructive notes.

Elementary Text-Book of Physiography. By W. Mawer, F.G.S. London: John Marshall and Co. Hull: Elsom and Co.

The term "physiography" is only of recent introduction, and is not always used in exactly the same sense. Sometimes it is used as a synonym for the discarded expression "physical geography," and sometimes, as in the present case, it stands for what might be considered as an abridgment of Humboldt's "Cosmos," differing, in fact, but little in meaning from the old term "cosmography."

The work before us gives a very fair summary of the present state of human knowledge concerning the world, its features, and the various forms of energy which we find in operation. In a few cases the author pronounces perhaps somewhat too positively, on questions which have not yet been thoroughly decided. Thus he accepts the view that the great oceans and the continents occupy respectively, at least to a very great extent, the same regions which they have always done. We detect only one decided error: on page 86 the author states the snow-line on the southern slopes of the Himalayas is higher than on the northern side. The very contrary is the case, as Mr. Mawer, curiously enough, subjoins to his statement the very reasons why the snow-line on the northern slopes should be higher, despite of latitude and exposure to the sun. Hence we suspect that we have here to do merely with a clerical error.

We are much pleased to find that the work is distinctly evolutionist in its teachings. He recognises that the distinctions once admitted between the vegetable and the animal world are disappearing, and furthermore that man in his highest faculties differs from some of the lower animals not in kind, but only in degree.

We are surprised, however, to find the bacteria classed among animals.

Within the narrow compass allotted (250 pages) the author has not only compressed a vast amount of valuable information, but he has arranged it clearly, displaying the great phenomena of the world in their natural relations.

The Naturalist's Diary: a Day-Book of Meteorology, Phenology, and Rural Biology. Arranged and Edited by Charles Roberts, F.R.C.S., L.R.C.P., etc., London: Swan Sonnenchein, Le Bas and Lowrey.

This is a book which, in our opinion, will prove exceedingly useful. It will show naturalists—and especially young naturalists—how their desultory observations may be correlated and co-ordinated so as to become of value. We are much gratified to find the formal recognition of a truth with which we have been impressed almost from our boyhood, that is, the superiority of the biological over the physical methods of distinguishing climates. The physician, the sanitarian, the farmer, the gardener, and indeed all that are interested in that wonderful complex which we call "climate," will learn more from the leafing, blossoming, and fruiting of plants, from the migrations of birds and the appearance of insects than they can possibly do from even the skilful use

of meteorological instruments. But the observations of the botanist or the entomologist, etc., to be of value must be made regularly and preserved for reference and collation.

The bulk of the book before us is in the form of a journal, a page for each day in the year. At the head of the page we find headings for meteorological observations. Then follow in succession plants and trees, blossoming, leafing, seeds germinating, etc.; insects, larvæ, etc., appearing, or to be especially looked for; fish, reptiles; birds, their migration, song, nesting; "animals" seen, or breeding; and, lastly, "shooting, fishing, sports." On these various headings a few remarks will not be uncalled for. The registration of temperature, rain-fall, wind, etc., in connection with biological observations is of great importance.

The rubric for insects appearing or to be looked for is too restricted. With exceptions almost too few for notice, the lepidoptera alone are recorded. Hence a naturalist who should study the appearance, reproduction, etc., of the coleoptera, hymenoptera, and the like would not find spaces to record his observations. There is no column for mollusca, whether inhabiting the land or the water. The heading "animals" takes us by surprise. It is evidently here used as an illegitimate synonym for "mammals" or "mammalians," a sense in which we have never before heard it used by any scientific man. Nor can we imagine what plea can be urged on behalf of its adoption. Lastly, the heading "shooting, fishing, sports" seems to us quite out of place. The times when these pursuits are followed are fixed by law or by custom, and are not perceptibly affected by the peculiarities of the seasons or by the geological character of the district.

We should, therefore, advise the young naturalist, after making himself thoroughly master of the invaluable instructions contained in the preliminary portion of this work, to draw out the diary on a larger scale in a blank book, leaving ample room for observations on insects other than lepidoptera. The times when many species may be expected to appear will be found tabulated in "Observations in Natural History," by the Rev. L. Jenyns.

The Liver-Fluke and the Rot in Sheep. By Edward Halse, A.R.S.M. Edward Stanford.

This essay gained the prize offered to the present and past students of Tamworth and Aspatria Colleges by Miss Ormerod. It is mainly a compilation from various memoirs scattered through the scientific and agricultural journals. The importance of the study of this disease is evident when we state that in the year 1879-80 6,000,000 sheep, about one-tenth the whole quantity in the United Kingdom, suffered from the rot. The life history of this parasite is a very interesting one on account of the number of metamorphoses through which it passes. Commencing with the egg, which escapes from the sheep, it is washed into a stream or pond, and there developes into a little embryo which swims about in the water until it finds a small snail to which it attaches itself. It then bores its way into the snail's body, and there developes into a number of cells, each of which contain germs which either break up into other similar cells or develop into tadpole-like creatures. The latter wriggle themselves out of the snail and swim again in the water. After a short time they attach themselves to blades of grass, draw themselves into a ball, and surround themselves with a white covering, thus becoming a cyst. When eaten by a sheep, the outer covering is crushed, and the liberated fluke works its way into the liver, where it rapidly increases in size.

Damp wet soils are the favourite abode of this pest, and drainage will frequently get rid of it. Lime and salt will kill the creature while it is in its tadpole-like existence, and it is well to dress pastures in which the fluke is known to exist with these substances during the months of May, June, and July.

We can strongly recommend this little work to all who are interested in sheep farming.

Practical Guide to Photography. By Marion and Co. London: Marion and Co.

We have no doubt that this little book will prove useful to persons about to embark in the pursuit of photography as a recreation. The method of describing the various manipulations of every-day photography is sufficiently ample for all practical purposes, without being likely to frighten the beginner by its complexity. The chapter on photographic optics commends itself to us as treating plainly a subject of which beginners have frequently little knowledge, long after they have mastered the production of creditable photographs by "rule of thumb." We think a chapter on the Chemistry of Photography should be included in the next edition of this work, even though it is avowedly intended for the use of beginners; as without an intelligent interest in the actions of the chemicals employed, the production of photographs is little more than a mechanical operation that loses its attraction to amateurs when a certain degree of proficiency is attained.

Lecture Notes and Problems on Sound, Light, and Heat. By Chas. Bird, B.A., F.G.S. (London: Relfe Bros. 1886. 9d.)

The title sufficiently explains the purport of this little *brochure*. It cannot be used as a substitute for real work, but it may profitably accompany it, and it would also, in some cases, serve well as a skeleton of notes for the use of lecturers.

Biliousness; its Causes and its Rational Treatment. By A. E. Bridger, B.A., M.D., F.R.C.P. London: Henry Renshaw.

Medical books written for the public are open to grave objection. As a rule they lead to one of two results; the reader, if he finds the cap fit, either attempts amateur doctoring or betakes himself as a patient to the writer of the book. From the first of these results come evils which very few outside the medical profession fully appreciate; from the second come possible benefit to the patient, and certain profit to the doctor. Unfortunately, however, for him, his colleagues have a troublesome way of looking upon such an increase in his earnings as the outcome of undignified advertisement and puffery, which must to some extent detract from its value even in his eyes.

The book before us is a favourable specimen of its class, but to the uninstructed it will convey a groundless impression that the physiological and pathological problems underlying the complex phenomena of biliousness have at length been solved, and that its treatment is now put upon a purely scientific basis, instead of resting, as in fact it does, despite the author's theorising, upon a very imperfect mixture of science and empiricism.

The medicines and courses of treatment which are

recommended by the author are in common use among physicians, but we must remind our readers, lest they hasten in search of a cheap substitute for the family doctor, that it is one thing to take pills and quite another thing to make the diagnosis which converts those pills from dangerous weapons into useful remedies.

Journal of the Society of Telegraph Engineers and Electricians. Vol. xvi., No. 68. (London and New York: E. and F. N. Spon.)

Perhaps the most generally interesting paper in this issue is that of "Deep-Sea Soundings in connection with Submarine Telegraphy," by Mr. E. Stallibrass. The author points out how little precise information we even yet possess concerning the bed of the ocean. Captain Maury's notion of the bed of the sea between Ireland and Newfoundland being a plateau, which seems to have been placed there expressly for the purpose of holding the wires of a submarine telegraph, can now no longer be maintained.

Institution of Mechanical Engineers. Proceedings, August, 1887, Edinburgh Meeting.

The papers read at this congress are of too purely technical a nature to admit of discussion in our pages. There is an account of the electric light on the Isle of May, by Mr. D. A. Stevenson, F.R.S.E. It appears that on account of the large first cost and yearly maintenance, the Trinity House have resolved to adopt the electric light in the most important positions only, and this decision the author regards as judicious. The May Island lights are probably the most powerful existing in the world.

Professor Sir William Thomson, F.R.S., delivered an important lecture on "Ship Waves," which he introduced by an interesting account of waves in general. He mentioned that in light-waves the vibrations occur perpendicularly to the line of progression of the wave. In sound-waves, on the contrary, the vibration is along the line of propagation of the wave. Waves of water agree more nearly with light-waves than with sound-waves.

LEAP-YEAR.

ACCORDING to the original Roman calendar, the civil year began with March, and was divided into ten months, consisting of an unequal number of days, in all 304 days. It was, however, soon discovered that on the same day in successive years there was a considerable difference in the number of hours during which the sun was above the horizon. Accordingly two months were added to the year. Numa, in imitation of the Greeks, divided the year into twelve months, according to the course of the moon, of 30 and 29 days alternately, making 354 days, and as an even number appeared of bad portent, he added a day, making the year consist of 355 days.

But this lunar year was seen to be too short in comparison with the solar year, to the extent of about ten days. Accordingly Numa intercalated every other year an extraordinary month of 22 and 23 days alternately. It was, however, left to Julius Cæsar, great in calculation as well as in war, to grasp the difficulty with a practical hand. He got the celebrated astronomer, Sosigenes, of Alexandria, to adjust the error. That was in the year 47 B.C.—the last year of confusion—which contained fifteen months or 445 days. Everything then proceeded pretty regularly from the first of January. The solar year having been found to consist of 365¼ days, Julius Cæsar enacted that every fourth year should consist of 366 days. This was called the "leap-year," or bissextile year, when February had 29 days. With the assistance of Flavius, he assigned to the months the number of days which they still retain. After his great name that year continued for sixteen centuries to be called the "Julian year" all over intelligent Europe, and Russia to this day. In Christian countries it has been, with a modification, the standard year; and that modification of the "new" from the "old" style we will now explain.

Astronomers found, by pretty accurate calculation, that the time between the sun's leaving a certain point in the ecliptic and its return to that point consists of 365.242218 days. This differs from the Julian year by .007782 of a day. Accordingly, in the time of Pope Gregory XIII. (1582), astronomers observed that the spring equinox (when day and night are of equal duration), which at the time of the Great Council of Nice (325) had been on the 21st of March, then strangely happened on the 10th of March. Between these two dates there is an interval of 1257 years. If, then, the difference between the Julian year and the mean solar year is .007782 of a day, the difference in 1257 is found to be 9.7819 days. This accounts for the ten days. Thereupon Pope Gregory ordered ten days to be omitted in that year.

But an adjustment had to be made for the future to prevent the recurrence of the error. He saw that adding a day to every fourth year was too much, and that in 400 years the error would amount to 3·1128 days. Accordingly he ordered that for the future in every 400 years three of the leap-years should be omitted. This was done by fixing on those which complete a century; and in the case when the number that expresses the century is exactly divisible by 4, the leap-year is to be allowed, but in the other three it is to be omitted. Except in these centuries, 1700, 1800, 1900, all the years whose numbers are exactly divisible by 4 from 1600 to 2000 are leap-years.

Last leap-year occurred in 1884, and then there were five Sundays in February. When will that occur again? If it be observed that 1900 is not a leap-year it can be easily found that the "charmed" year will be 1920.

THE GASTRIC JUICE AFFECTED BY SLEEP.

DR. P. V. BURJINSKI, of St. Petersburg, has made some investigations on the effect of sleep upon the acidity of the gastric juice. He estimated this acidity by means of a standard solution of soda, and he tested it also for hydrochloric acid. The best test for the latter he found to be phloroglucin-vanillin. As, however, this cannot be used when there is any yellow colour in the fluid to be tested, the subjects of the experiments were fed on the whites of eggs, all the yolks being carefully put aside. The result of numerous tests showed that during the night the gastric juice is less acid than during the day. Care was of course taken that the conditions regarding food were the same during the night as during the day. Dr. Burjinski also found that the amount of acidity varied directly with the amount of hydrochloric acid present.

Abstracts of Papers, Lectures, etc.

ROYAL INSTITUTION.

The Great Planets.

In his fourth lecture Sir R. Ball informed his hearers that the stars which could be seen were only a small part of the universe. One of the grandest conceptions of astronomy was that all the stars we could see were only one group, one cluster. There was no more beautiful object than the Milky Way. Through a telescope it was seen to be composed of myriads of minute stars, looking minute because of their immense distance; and our sun was but one of the vast host of stars therein comprised. Therefore the Milky Way consisted of stars separated by the most appalling distances from each other. From some parts of the universe it could not be distinguished as other than a little cluster of stars in the sky. Coming to the subject of the planets, the lecturer remarked that between Mars and Jupiter there was a multitude of little planets only a few miles in diameter, and not visible except through a large telescope. On one of these little planets gravity would be so slight that an inhabitant, falling, would come down as gently as if lying down on a feather-bed. The vastness of the craters in the moon was accounted for by the diminished gravity as compared with that of the earth, the effect of a volcanic explosion being to throw the matter a much greater distance than would be the case upon the earth. With the same effort required here to lift fifty-six pounds or to throw a ball a hundred yards, a man on the moon would lift six times as much, or throw a ball six hundred yards. On the larger planets a fall would be more serious, and weight would be much greater than on the earth. Jupiter, the largest planet of the solar system, more than a thousand times the size of the earth, appeared through the telescope as a vast globe, marked all over with cloudy bands. It seldom looked alike for long together, as it revolved on its axis in nine hours. There were no traces of solid continents or oceans, only a stupendous mass of cloud; and it was very doubtful if our telescopes had ever yet enabled us to see the solid interior. The moons were much larger than the earth's satellite; and it was by observation of the rays of light falling from those satellites that the theory of the aberration of light was discovered. Jupiter was not perfectly round, but bulged as it were in the centre, no doubt owing to its rapid revolution on its axis. This was illustrated by experiments with a revolving chain loop and rotating springs. Passing to Saturn, Sir Robert Ball described it as the most beautiful object in the heavens, and exhibited a model of it, as well as a number of pictures showing the progress made in observing the planet from ancient times. Saturn travelled round the sun in a very wide orbit, occupying about thirty years, and was very much larger than the earth. Up to about one hundred years ago Saturn was the farthest planet from the sun which had been discovered, only five being then known.

The Comets.

In the fifth lecture the Astronomer Royal of Ireland dealt with the great and small comets. Having illustrated the elliptical nature of their course, he explained how, as they neared the sun, their volume, under the influence of its intense heat, expanded, and the tail was produced and developed, while their rate of progression was augmented until they travelled many hundreds of miles per second. Illustrating this by a light, hollow ball of iron, he showed how in its progress it attained a speed sufficient to insure its continuing on its course, notwithstanding the attraction of a powerful magnet which, however, was strong enough to deflect it from the line it would otherwise have pursued, and compel it to describe a parabola. As it receded from the centre of attraction the comet's speed gradually diminished, until at last it crawled along "at a pace which any old omnibus would despise." The commonest form of comet was that of which a specimen was seen in 1843, which, after travelling on for thousands of years, attained such an enormous speed as it neared the sun that it passed round it in two hours. The intense heat to which comets were exposed as they approached the sun drove the gaseous substance of which they were composed into smoke and vapour, and thus was formed the tail, which was always seen directed from the sun. Some of the more remarkable comets were shown in illuminated transparencies and the lecturer called special attention to Halley's comet, which came round every seventy-five years, its next appearance being due in 1910. The movements of this comet had been followed for nearly 2,000 years, and the great comet recorded to have been seen before the birth of Christ, and again in 1066, when a drawing was made of it which was reproduced in the Bayeux tapestries, had been shown to be that which we knew as Halley's. As to the direful predictions that were sometimes made of what would happen if the earth ever came into collision with a comet, the lecturer explained that these eccentric visitors were composed of merely gaseous or possibly semi-liquid material, and that the largest of them would not weigh more than a few tons. On Midsummer Night, 1861, the earth actually did pass through the tail of a great comet, and, with one solitary exception, nobody noticed anything unusual, the only serious consequence being that a certain country rector was compelled to suspend his sermon until candles had been procured to enable him to continue reading it. The relation between a comet and the splendid display of shooting stars on November 12th, 1866, was explained, and the lecturer observed "that as this particular comet returned every thirty-three years the same phenomena would be seen on the 12th or 13th of November, 1899. Sir R. Ball pointed out the insignificance of our sun in the scheme of the universe, many of the stars which we saw at enormous distances being really suns far brighter and grander than that from which we derived light and heat. The grandest truth in nature was that which expressed that our sun was only one, and not a very important one of some millions of suns which we saw twinkling throughout the universe. Were it and its whole system of earth and planets blotted out, all that would be noticed from those further worlds would be that another little star had ceased to twinkle.

The Stars.

The last lecture of the course was upon the stars. The question, "What is a star?" was one which a child often answered, but it was one to which a philosopher could give but a partial reply. Our sun was, after all, only a star, and all the other stars were suns. The difference in apparent brightness between the sun and the stars was due to the fact that we were close to the one and a long way from the others. About 6,000 stars could be

seen with the naked eye, but with quite a small telescope fifty times as many could be seen in the northern hemisphere alone. An opera-glass was an excellent instrument with which to observe the heavens. There were actual maps containing 324,000 stars in the northern hemisphere, and these could be seen through a small telescope. The stars seen with the naked eye were only an infinitesimal part of those which existed in space. The lecturer gave an interesting demonstration in trigonometry of the method of measuring the distance of the stars. Astronomers were obliged to resort to the longest base line they could get, and that was the whole orbit of the earth—nearly two hundred million miles. They did this by taking the triangles at an interval of six months. In this way they knew that the nearest star to us—Alpha, in the constellation of the Centaur—was twenty millions of millions of miles distant. It would take three hundred thousand years to count this number, counting fast day and night; or, if the distance were taken as a railway journey, at a fare of a penny per hundred miles, it would take a hundred and seven million pounds more than the National Debt to pay the fare. The stars of the constellation Hercules appeared to be opening out, and on the opposite side of the sky the stars were found to be drawing together, so that it was concluded that our sun and its planets were bound on a mighty voyage to the constellation Hercules. Twenty thousand miles of that journey had been taken in the fifty minutes that had elapsed since the beginning of the lecture; but we might travel for millions of years without reaching very far into the confines of that constellation.

GEOLOGICAL SOCIETY.

At the meeting held on January 11th, 1888, Prof. J. W. Judd, F.R.S. (President), in the chair, the following communications were read :—

(1) "On the Law that governs the Action of Flowing Streams," by Mr. R. D. Oldham. The author, after describing how his attention was drawn to the subject, proceeded to an investigation of the law that governs the action of a flowing stream. Having accepted as a fundamental principle that the velocity of a stream will always tend to become such as is just sufficient to transport the solid burden cast on to the stream, he finds that, where untrammelled by exterior conditions, a stream will be alternately confined to a single, well-defined, deep channel, and spread out into a number of ill-defined, shallow channels, the former being defined as a "reach," the latter as a "fan," that the gradient in the "reach" is less than on the "fan," and that both "reach" and "fan" will continually be encroaching at their upper ends, and being encroached upon at their lower ends. After pointing out that what should occur according to hypothesis, does actually occur in nature, the author said that accepting this agreement of fact with hypothesis as proof of the correctness of the latter, it follows that the fundamental principle on which it is founded is correct, and that, in the absence of interfering causes of greater potency, it is the coarseness or fineness of the debris cast upon a stream that will determine its gradient and velocity, and not, as stated in text-books, the velocity of a stream that will determine its gradient and the coarseness of the debris transported by it:—a conclusion that might be arrived at independently, from the fact that it is in the upper reaches of a stream, where coarse debris prevails, that high velocities of current prevail, while in the lower reaches, where the debris is finer in grain, the velocity of current is also diminished.

(2) "Supplementary Notes on the Stratigraphy of the Bagshot Beds of the London Basin," by the Rev. A. Irving. This paper contained the results of field-work during the year 1887. Additional notes on the stratigraphy of the Bracknell and Ascot Hills were given, justifying the reading of the country as shown in figs. 1 and 2 of the author's last paper (Q. J. G. S., August, 1887), the examination of this line of country having been extended as far as Englefield Green. The stratigraphy of the hills known as Finchampstead Ridges has been worked out from numerous sections on their flanks; and the strata of the Bearwood Hills were correlated directly with them. All along the northern margin a general attenuation of (*a*) the lower (fluviatile) sands, of (*b*) the middle (green earthy) sands was shown to occur, and in some places on the northern margin they are found to have entirely thinned away, admitting of distinct overlap at more than one horizon.

The second part of the paper dealt with the Highclere district, where the author believes he has established the full succession of the three stages of the Bagshot Formation.

Some important conclusions were drawn as to the Tertiary physiography of the South of England; and the revised tabulation of the Tertiaries put forward by Prof. Prestwich at the Society's last meeting was referred to as supporting some of the main points for which the author has contended.

(3) "The Red-Rock Series of the Devon Coast Section." By the Rev. A. Irving.

From a recent examination of this section, and from the facts furnished by Mr. Ussher's paper (Q. J. G. S., vol. xxxii., pp. 367 *et seq.*), the author has arrived at the conclusion that the series of red rocks between the Lias to the east of Seaton and the Carboniferous of Devon, formerly described under the title of "New Red Sandstone," cover the period of geologic time which that term signified, and that the lower members of the series belong, not to the Trias, but to the Permian or Post-Carboniferous. He considered that at the base of the Budleigh-Salterton Pebble-bed there is a physical break of as much significance as that between the Trias and the Permian of the Midlands. From this point eastwards the Triassic system is represented by a series of rocks quite comparable with the Bunter and Keuper of the Midlands, the Bunter being here represented by the Middle Division (about 200 feet thick) and the Upper Division of Prof. Hull.

In the marls which underlie the Budleigh-Salterton Pebble-bed, he recognised the equivalents of the Permian Marls of Warwickshire and Nottinghamshire, and of the Zechstein Marls of Germany. These pass, by a gradual transition, through Sandstones, becoming more and more brecciated, into the great brecciated series of Dawlish and Teignmouth, which were regarded as the equivalents of the great Permian breccias of the west of England, of Ireland, and of the Lower Rothliegendes of Germany.

All the rocks below the Budleigh-Salterton Pebble-bed were regarded as the assorted materials furnished by the detritus of the palæozoic mountain-region of Devon, Cornwall, and Brittany, and as representing the waste and degradation of that region, deposited on the mountain-flanks and in land-locked bays during Post-Carboni-

ferous times, the marls being compared with the Nyirok of the Austrian geologists.

ROYAL METEOROLOGICAL SOCIETY.

The monthly meeting of this Society was held on Wednesday evening, the 18th inst., Mr. W. Ellis, F.R.A.S., President, in the chair.

The paper read was "The Non-Instrumental Meteorology of England, Wales, and Ireland," by Mr. G. M. Whipple. This was a discussion of the observations of wind, cloud, thunderstorms, hail, snow, etc., made at the stations of the Royal Meteorological Society during the eight years (1878-1885), and published in the *Meteorological Record*. The S.W. wind is the most prevalent, and blows on the average seventy-four days in the year; the W. wind occurs almost as frequently, blowing sixty-five days. The least dominant winds are the S.E. and N., which occur on twenty-seven days, and the N.E. on thirty-two days. Thunderstorms are most frequent in the eastern and midland counties, and least frequent in the north of Wales.

Mr. Ellis, in his presidential address, reviewed briefly the work and position of the Society, remarking that such a Society, whilst unable to carry out expensive original or experimental work, could yet act with great advantage in inciting volunteer workers throughout the country to united action, of which one recent example was the ready response to the request of the Society for Photographs of Lightning, an excellent collection of which had been obtained, and which would shortly be exhibited; in addition to which arrangements were being made for the more systematic observation of thunderstorms. Referring to the question of sympathetic relation between sun-spots and magnetism and meteorology, he thought that any complete treatment of the question in its meteorological aspect seemed to require that it should be dealt with in a much more comprehensive manner than before, for which purpose observations more completely covering the surface of the globe might be necessary—if, indeed, not necessary also for the solution of many other meteorological questions, the present meteorological stations being distributed over the earth in such isolated clusters. The attention given to synoptic charts was most important, but the general meteorological characteristics of places should also still continue to be studied. In concluding, Mr. Ellis said that at one time the science of meteorology seemed likely to form an exception to the general rule of advance, for more than any other it has required the united action of many workers, but the field of inquiry of late years opened out allows us already to talk of the New or Modern Meteorology—phrases typical of the advance achieved, although the knowledge gained seems only to remind us of how much has yet to be done.

ENTOMOLOGICAL SOCIETY.

At the anniversary meeting on the 18th ult., the President, Dr. D. Sharp, gave some striking illustrations of the vast variety of insect life which must exist on the earth. Dealing first with the public value of collections, he considered them as one of the resources of civilisation for improving the mental condition of the people. They are also instruments for scientific inquiry, and for this purpose their value increased in proportion to their completeness. Could we form an opinion as to how far advanced they are in this respect? Linnæus 120 years ago knew of only 3,000 species of insects, and at present he thought there were 200,000 or 350,000 in the collections of the world, indicating an advance that might be roughly stated to be at the rate of about 2,000 species a year. But from the collections obtained by recent travellers and from other data he inferred that we very likely do not possess yet more than one-tenth of those existing, so that at the present rate of progress we could not hope to complete our collections of insects in less than 1,000 years. But meanwhile, owing to the extension of the European races and destruction of the primitive forests, many species have doubtless become extinct, and others are rapidly dying out without any specimens of them being preserved in collections. He urged that we should endeavour to obtain those forms likely to become soon extinct, especially those of islands and archipelagoes. He wished it were possible to find some travelling naturalists, who would not only themselves collect, but would teach others who were willing to learn and resided in the localities they visited.

LIVERPOOL MICROSCOPICAL SOCIETY.

At the annual general meeting held on the 20th ult., the President (Mr. A. Norman Tate, F.I.C., F.C.S.) delivered the inaugural address on "The Application of the Microscope to Technological Purposes," in the course of which he said:—The microscope is no longer what it was a comparatively short time since, an instrument employed more especially for recreative purposes, for a few researches in natural history, and an occasional test by medical men and chemists. It has proved itself so largely useful in many directions that microscopy has become quite a science in itself, capable of being employed not only in scientific research, but also in very many of the practical applications of science, and demanding a large amount of careful systematic study. It has afforded to the physician and surgeon information of the greatest value, and during the last few years it has been especially serviceable in the study of micro-organisms in connection with health and disease, and in the examination of the minute structure of the tissues of the body. The work done by its aid in relation to bacteriology has been immense, and the results are being rapidly systematised and put to useful purposes; but, great as has been the progress of bacteriology, there is still a very wide field for further work, and room for very many new workers. Its study has already been made useful in examinations of the air for micro-organisms, but the work yet done in this direction is a mere trifle compared to the importance of the investigation in relation to health. In the examination of water the microscope has also been of great service of late years; and a very interesting case is mentioned by Dr. C. O. Harz, who, in examining the waters of the Schliessee, in Bavaria, when it was covered with ice, noted a dense turbidity at first, of a green or blue tinge, but becoming yellowish-red or a peach colour before finally disappearing. This was chiefly due to enormous quantities of apalmella, which was attacked and finally completely destroyed by a peach-coloured micrococus. Another practical purpose to which the microscope may be put is in the examination of foods, and especially in connection with the preparation, transit, and storage of preserved and other food-stuffs now so largely imported from abroad. Also, it is serviceable in detecting sophisti-

cations of foods and drinks, and continually is the microscope adding new means of detecting adulteration. Microscopy is again useful in noting the characters of fibres used in textile manufactures, and for cordage, paper-making, etc., and so important has this been considered in America that there was formed there in 1885 a National Textile Microscopical Association. In agriculture, also, the microscope is of great use. Even as regards the soil it has, by studying micro-organisms, taught much respecting the nitrification of the soil; but it is especially valuable in noting some of the diseases of plants, such as those caused by the ravages of fungi and minute insects. To the timber merchant, joiner, carpenter, cabinetmaker, and builder, the microscope is of use in noting unhealhty conditions due to fungoid growths, etc. The microscope may be a still further guide to builders in the examination of the mineralogical constituents of building stones, and in the same way it may be often serviceable in examining materials used for road-making, paving, etc. Microscopy is also serviceable in practical mineralogy, and capable of detecting mineralogical constitution where chemistry fails.

It is also serviceable to the brewer in noting the purity of the air in the fermenting room, the nature of the water, the quality of the ferment, including the presence or absence of organisms that cause unhealthy fermentation; and in the same way it is useful to the distiller, and others who have to work with saccharine liquids, such as the sugar refiner. In the mechanical arts microscopes have been employed with advantage in making delicate measurements and in delicate levelling operations; also in noting causes of difference in the efficiency of tools, consequent on the character of the materials of which they are made. One other use may be mentioned, viz., in connection with the legal profession in the examination in doubtful cases of handwriting, ink, and paper of documents, etc. In the study of microscopy a knowledge of drawing and the practice of photo-micrography can be of much service, and excellent progress in the latter art has been made of late years, but further developments should be sought for, especially in connection with observations with high power objectives. As the microscope is of so much value for practical purposes, it should be studied more than it is in science schools and in connection with trades and industrial occupations. Even in ordinary school teaching it might be made available for exciting greater interest in the studies than is often given now, and in giving a training in habits of thorough and careful investigation; but in trade and technical schools a training in its use should form an important part of the curriculum. In many such schools on the continent practice with the microscope is insisted on, and the value of such study has been testified to, not only by the professors under whose auspices the instruction has been given, but by a large number of manufacturers and others in whose service the students have subsequently worked.

SOCIETY OF ARTS.

At the meeting held on the 18th ult., Sir Richard Webster, M.P., presiding, Mr. John Leighton read a paper, on "A Proposal for a Postal Ballot." Mr. J. Withers, one on "Ballot Voting Apparatus," and Mr. J. Imray, a communication entitled "Apparatus for Voting by Ballot."

PHYSICAL SOCIETY OF GLASGOW UNIVERSITY.

At the meeting held on the 13th inst. Mr. Bunji Mano read a paper on the "Testing of Lubricants," in which he called special attention to the fact that in estimating the value to engineers of various lubricants, their constancy of action in keeping a cool surface with a low co-efficient of friction and a high temperature of decomposition was of much more importance than their money value.

ROYAL BOTANIC SOCIETY.

At a meeting of this Society, held on the 14th ult., Dr. Prior exhibited specimens of the sweet acorn called Bellotas, of which great quantities are brought into the markets of Northern Africa and Spain during the autumn months, and are eaten raw, boiled or roasted, or made into bread by the inhabitants.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE FOG-BOW.

Professor Tyndall has had the good fortune to witness a fog or mist-bow in Hampshire, and in his letter to the *Times* on the subject he mentions the rarity of its occurrence. It will doubtless be within the recollection of those members of the British Association who returned from Canada on the s.s. *Parisian* that a very well-defined and complete fog-bow was seen about 11 a.m. in the Gulf of St. Lawrence, during a white fog, which was so dense that the sea was invisible a few yards ahead of the steamer.

J. Emerson Dowson.

INSTINCTIVE FEAR.

Can any of your readers explain why some animals in times of imminent danger are said to feign death? Death is an unknown state to each living creature; how then can they feign it? Many facts are given showing the gradual acquisition of instinctive fear, or hereditary dread of man during the period of human observation; yet acute observers, like Charles Darwin, assert that in no one case has the attitude in which the animal feigned death resembled that in which the animal really died. Is the so-called instinct, then—at least in insects—merely an instinct to remain motionless in the presence of danger, and thus elude the notice of man? or is there anything more, and what is that more?

Observer.

SERPENT POISONS.

Your correspondent "Surinamensis" is correctly informed respecting the relation between the bites of venomous serpents and tropical fevers. Persons inoculated with diluted venom of the rattlesnake develop symptoms closely resembling those of yellow fever, and the venom in this form is largely used by the Homœopathic School both as a curative and prophylactic agent in the treatment of this fever.

Percy Wilds, M.D.

MICRO-ORGANISMS.

I notice in your first weekly number that "Sigismund" writes of the above:—"These tiny beings will very probably play in the future no unimportant part in the manufacture of organic products." That this, indeed, is extremely probable was pointed out by myself in the early part of last year, in the course of a discussion upon "Micro-organisms," at the Society of Arts.

Even at the present time the bulk of the alcohol, and all the indigo produced industrially, is really due to the vital develop-

ment of certain micro-organisms, and to similar agencies must be ascribed such part of the world's vinegar and acetic acid as is not obtained by the destructive distillation of wood, etc.

By the application of pure "cultivations" of different zymogenic organisms in special media, I have already obtained evidence that a number of alkaloids, glucosides, and neutral principles, chiefly of a highly toxic character, may be in small quantity produced, and I look forward confidently to that period of the world's history—although probably not within the span of my own life—when our most valuable drugs and medicines will be largely produced in *zymogenic factories* constructed expressly for such purposes.

The constitutions which must necessarily govern the initial designs for, and the subsequent working of, factories of this kind, are doubtless peculiar; with some of them I am perhaps even now acquainted, and in the event of your readers being at all interested in the subject, I may trouble you with a longer communication thereon at a later date. W. L. Scott.

WHY DO CLOUDS FLOAT?

Respecting the explanations offered* on the causes of the *floating of clouds* in the air, it may be mentioned that those adduced by the writer would scarcely be adapted for the different regions of the earth, though perhaps suited for this country. The old idea of the vesicle is the more generally useful form to consider cloud vapour as consisting of, as its collapse, into a solid, forms the raindrop, which falls to the ground by gravity. The vesicle will contain aqueous vapour and heat derived from the seas, surrounded by a hollow cell of water, as in a soap-bubble, and the flotation of this will depend on the difference of specific gravity of these contents and that of the external air.

In *equatorial* regions the temperature of the seas may be about 80°, while that of the sun in the superincumbent air may be 100° at the cloud levels. The cloud vesicle would at first contain vapour at 100°, enclosed in a capsule of water at 80°, and this would be maintained if the cloud remained stationary. If the heat of the sun increased, then these vesicles would rise by levity of contents and carry the clouds into the upper levels of the atmosphere. If they reached the levels of identical specific gravity above, and their envelope became cooled and incohesive, then the cell would collapse and fall down as rain. The white clouds in the equatorial regions are either stationary or move upwards only, and remain for long periods suspended in immense woolly masses in homogeneous temperatures. The persistence of clouds in the *temperate* regions will depend on their continuing in the body of the same wind, which though shifting its place continually, yet will remain of the same temperature for long periods, and thus the cell contents will be kept at the same levity and temperature.

Clouds in *temperate* regions will be brought only from southern and western quarters of the earth, as from these only they could get cell contents of greater temperature and levity than the atmospheres they ride in in more northern latitudes. Hence, no clouds could generally be expected to be derived from northerly or easterly quarters of the earth, because the cell contents would be colder and denser than the air they sailed in in southern regions. So that long ere that they would have disappeared as vapour.

The cloud vesicles may thus be considered as useful microscopic balloons, and viewed as the means of transporting the riches of heat and moisture from the tropics to the desert regions of the globe, round the Arctic circles north and south.

These cell contents, when liberated by physical dissolution of their envelopes, then fall to the earth as warm rain, and likewise give out their caloric, when it is then sensibly felt in the atmosphere. W. J. Black, F.R.M.S.

ANSWERS TO CORRESPONDENTS.

John Lewis.—The subject of your communication is too medical for discussion in our columns.

* Scientific News, Vol. I., p. 9.

RECENT INVENTIONS.

The following list has been compiled especially for the Scientific News, *by Messrs.* W. P. Thompson *and* Boult, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

Paper File.—A file for papers has been patented by Mr. A. E. Walker, of Milton Street, E.C. It is provided with a spring clip, which has the advantage that the clamping-bar when down holds the paper placed under it with a firm grip, while it can easily be turned back, thus taking the pressure completely off the papers, and when lifted remains back automatically. The papers can thus be referred to, and the clamp applied again.

Toboggan.—Messrs. Whellans and Beswetherick, of Dean Street, Soho, have patented a toboggan. The object of this invention is to provide a sliding surface in lieu of ice and snow. For this purpose tracks of wood are provided, the tracks having rods of metal fixed on their surface at suitable distances apart, either longitudinally or transversely, for the toboggans to slide over; or, if preferred, the tracks may be faced with corrugated metal. The toboggans are of the ordinary pattern, except that they are faced with metal at the bottom to suit the form of metal on the track.

Gas Burner. — An inverted gas-lamp has been patented by Mr. D. W. Sugg, of Vincent Street, Westminster. The apparatus consists of an annular body, which is placed in an inverted position, and is carried by two hollow arms which connect the body with a chimney, and serve as flues to conduct the products of combustion to the chimney. The centre of this body forms an air channel to the burner, and is open to the external air, except that an adjustable outer guard is employed to ensure an even and proper supply of air passing to the air channel to feed the flame and produce proper combustion.

Oil Lamps.—Mr. E. Sundborg, of Mundella-road, Battersea, has patented an improvement in oil lamps, to prevent the bursting of the reservoir. For this purpose there is made a safety opening on the top of the reservoir, provided with a spring valve, to prevent the liquid contents from running out if the lamp be upset. The spring valve or other covering is so arranged that any pressure from sudden explosion inside the lamp would open it and relieve the pressure, and there would be no fracture and no conflagration. Old lamps may be fitted with this safety valve.

Fire-Proof Curtain for Theatres.—Messrs. Heath, Kings and Geddes, of 46 Fairmead Road, Islington, have patented a fire-proof curtain for theatres. A trench is formed below the floor of the cellar close to the proscenium wall, and a roller is placed therein; above this is placed another roller, round which is wound the fire-proof screen. The screen is a canvas, and is carried from the upper roller round and under the roller in the trough; the trough contains a solution of tungstate of soda, which renders the screen impervious to the action of fire. Immediately over the rollers is formed a narrow hinged trap extending across the stage. A light iron lattice girder extending the width of the curtain serves

to form a rigid curtain rod, and to its lower edge is fastened the curtain.

TROUSER STRETCHER.—Mr. J. H. Johns, of New North Road, Islington, has patented a trouser stretcher. The stretching device consists of an eccentrically pivoted roller and a fixed piece, the two being placed parallel, and the roller extended from the fixed piece by any convenient means, the suspending devices having holes therein as bearings for the pivots of the rollers. When a pair of trousers is to be stretched, it is folded at the knees over the stretching roller, which then has that part of its periphery which is farthest from the pivots at the nearest position it can reach to the clamping device. The trousers being clamped, the roller is, in order to effect the stretching, turned over away from the clamping device, and is fixed in any desired position according to the amount of stretching required.

SCULLING APPARATUS.—An apparatus for concentrating the power of a sculler has been patented by Mr. T. P. Wood, of Newcastle-upon-Tyne. The object of this invention is to transmit the muscular power exerted by the legs to the handles of the oars. The apparatus consists of a belt about 3 inches wide which runs around the body and over the sacrum of the sculler with a small pulley attached to it near each hip-joint. Around such pulley runs a cord, one end of which is attached to the sliding stretcher, and the other to the handle of the scull. One end of a strap about 1½ feet long is attached to a band which runs around the right thigh of the sculler, and the other end to the left thigh. This strap is connected to the boat behind the sculler in such a manner that if the boat capsized the sculler would be set free, and it prevents the sculler from slipping off the seat during the stroke.

SAFETY ATTACHMENT FOR WATCHES.—Mr. A. M. Clark (a communication from Mr. H. D. Martin-Pouget, of Paris) has patented a safety attachment for watches which is contained in a hollow case of cylindrical form, provided with a ring at lower end for attachment to the bow of the watch. The attachment consists of one or more pairs of claws pivoted to a head at the inner end of a longitudinal rod sliding through the upper end of the casing and terminating in a swivel for attachment to the watch-chain, the points of the claws passing through longitudinal slots at opposite sides of the case. The claws are normally held retracted by a spiral spring. If the chain be pulled at for the purpose of abstracting the watch, the claws will be projected outwards and catch in the pocket-lining, but the watch can be readily withdrawn from the pocket by the wearer by taking hold of the case, the claws then remaining in their retracted position.

SNOW REMOVER.—An improved apparatus for clearing snow has been patented by Mr. E. Burton, of Nine Elms, engineer. The invention relates to a machine for removing loose snow from the middle to the side of public thoroughfares in order to facilitate vehicular traffic. The machine consists essentially of a row of scrapers or brushes mounted side by side upon a suitable framing, and set obliquely to the line of progress of the machine, which is mounted upon wheels, and provided with shafts and a driver's seat. These scrapers deflect the snow to one side of the thoroughfare as the machine advances; they are free to slide up and down independently, to permit of their following the inequalities of the road surface, on to which they are pressed by springs, and they may be raised simultaneously when the machine is out of work, or to pass over an obstacle, by means of chains attached to the scrapers, and a winding roller above operated by a handle within reach of the driver, the same motion relieving the downward bearing of the springs on the scrapers.

ANNOUNCEMENTS.

UNIVERSITY OF EDINBURGH.—Mr. John Rankine has been appointed to the chair of Scotch Law.

DOUAI (FRANCE).—The University of this town has been removed to Lille, much to the regret of the inhabitants. The University of Douai was established in 1560.

DUBLIN.—Dr. R. F. Scharff has been appointed curator of the Natural History Department of the Science and Art Museum, Dublin. He has been an assistant in the museum for some months.

THE CHAIR OF BOTANY AT EDINBURGH UNIVERSITY.—It is understood that Professor Bayley Balfour, of Cambridge, will be a candidate for the Chair of Botany vacated by the death of Professor Dickson.

CAMBRIDGE.—Sir Fredk. Augustus Abel, C.B., D.C.L., F.R.S., has been appointed Sir Robert Reade Lecturer. Mr. H. D. Rolleston, B.A., of St. John's College, has been appointed Demonstrator of Pathology.

THE MELBOURNE EXHIBITION.—The Victorian Government has assented to the proposal of France that the time allowed for the admission of exhibits to the Melbourne Centennial Exhibition should be extended to March 1st next.

PRIZE FOR ELECTRIC LIGHT INSTALLATION.—The Société Industrielle of Amiens offers a prize for "The best electric light installation in industrial works." The Installation must give as good an illumination as a gas system of not less than 300 gas jets, it must be proved to be cheaper than gas made on the premises, and the light must have been in operation for a year. Detailed plans and descriptions must be sent in before the 30th of April next.

FRENCH SCIENTIFIC HONOURS.—The French Academy of Sciences have announced the awards for the current year in a recent number of their *Comptes Rendus*. In chemistry the *Prix Jecker* has been divided between M. Arnaud for his work on the new alkaloid cinchonamine which he has succeeded in isolating from the bark of *Remijia purdiana;* and M. Haller, the Professor in the Faculty of Science at Nancy, for his interesting researches on the camphors.

ENTOMOLOGICAL SOCIETY OF LONDON.—The following gentlemen have been elected as Officers and Council for 1888:—President, Dr. David Sharp, M.B., F.Z.S.; Treasurer, Mr. Edward Saunders, F.L.S.; Secretaries, Mr. H. Goss, F.L.S., and the Rev. Canon Fowler, M.A., F.L.S.; Librarian, Mr. Ferdinand Grut, F.L.S.; and as other Members of Council, Mr. Henry J. Elwes, F.L.S.; Sir John Lubbock, Bart., M.P., F.R.S.; Mr. Robert M'Lachlan, F.R.S.; Mr. P. Brooke Mason, M.R.C.S., F.L.S.; Mr. Edward Poulton, M.A., F.L.S.; Mr. Osbert Salvin, M.A., F.R.S.; Mr. Henry T. Stainton, F.R.S.; and Lord Walsingham, M.A., F.R.S.

THE PHARMACEUTICAL SOCIETY.—The following gentlemen have been appointed Examiners for the Pharmaceutical Society of Great Britain for the ensuing year, and have been approved by the Privy Council under the provisions of the Pharmacy Act, 1868, viz.:—England and Wales—James Benjamin Barnes, Thomas Porter Blunt, John William Bowen, Octavius Corder, George Claridge Druce, John Fletcher, Samuel Gale, Alfred William Gerrard, Thomas Edward Greenish, Francis Ransom, William Henry Symons, Alfred Edward Tanner, George Spratt Taylor, and John Clough Thresh. Scotland—William Inglis Clark, David Brown Dott, Adam Gibson, William Gilmour, Alexander

Kinninmont, Thomas Maben, John Nesbit, and John Bertram Stephenson.

Royal Meteorological Society.—At the annual general meeting the following gentlemen were elected the Officers and Council of the Society for the coming year:—President, William Marcet, M.D., F.R.S., F.C.S.; Vice-Presidents, Francis Campbell Bayard, LL.M., William Ellis, F.R.A.S., Charles Harding, Richard Inwards, F.R.A.S.; Treasurer, Henry Perigal, F.R.A.S., F.R.M.S.; Trustees, Hon. Francis Albert Rollo Russell, M.A., Stephen William Silver, F.R.G.S.; Secretaries, George James Symons, F.R.S., John William Tripe, M.D., M.R.C.P.Ed.; Foreign Secretary, Robert Henry Scott, M.A., F.R.S., F.G.S.; Council, Hon. Ralph Abercromby, Robert Andrew Allison, M.P., Edmund Douglas Archibald, M.A., William Morris Beaufort, F.R.A.S., F.R.G.S.; Henry Francis Blanford, F.R.S., F.G.S., Arthur Brewin, George Chatterton, M.A., M.Inst.C.E., William Henry Dines, B.A., Henry Storks Eaton, M.A., Baldwin Latham, M.Inst.C.E., F.G.S., Edward Mawley, F.R.H.S., Charles Theodore Williams, M.A., M.D., F.R.C.P.

DIARY FOR NEXT WEEK.

Monday, *Feb.* 6.—Camera Club, at 8 p.m.—*Conversazione.*
Victoria Institute, at 8 p.m.—Paper by M. Maspero, or Mr. S. T. Klein, F.L.S.
Aristotelian Society, at 8 p.m.—*Wundt's Theory of Apperception;* Mr. J. S. Mann.
London Institution, at 5 p.m.—*The Asmonæans;* Rev. William Benham, B.D.
Royal Institution, at 5 p.m.—General Monthly Meeting.
Society of Chemical Industry.—*The Alkaloids, a Review of the Synthetic Methods of Preparing "Closed Chain" Azo-carbon Compounds;* Dr. H. E. Armstrong, F.R.S.
Society of Engineers, at 7.30 p.m.—*Inaugural Address;* Mr. Arthur T. Walmisley.

Tuesday, *Feb.* 7.—Royal Institution, at 3 p.m.—*Before and After Darwin;* Professor G. J. Romanes, F.R.S.
Society of Biblical Archæology, at 8 p.m.—*Promominal Forms in Egyptian, their Relation to Semitic;* Mr. P. le P. Renouf. *Account of the Raising of the Two Colossal Statues of Rameses II., at Memphis;* Major A. H. Bagnold, R.E.

Wednesday, *Feb.* 8.—Royal Microscopical Society, at 8 p.m.—Annual General Meeting. *President's Address.*
Sheffield Pharmaceutical and Chemical Society.—*The Present Position of Toxicology;* Mr. J. O. Arnold, F.C.S.

Thursday, *Feb.* 9.—London Institution, at 6 p.m.—*Primitive Natural History;* Professor G. J. Romanes, F.R.S.
Royal Institution, at 3 p.m.—*Early Secular Choral Music;* Professor C. H. H. Parry.
Society of Telegraph Engineers and Electricians, at 8 p.m. Edinburgh Architectural Association.—*The Mediæval Monastery, its Place in the History of Architecture;* Professor G. Baldwin Brown.
Mathematical Society, at 8 p.m.—*On the Volume Generated by a Congruency of Lines;* Mr. R. A. Roberts. *Vibrations of an Elastic Spherical Shell Containing a Given Mass of Liquid;* Mr. A. E. H. Love. *Isocelians;* Mr. R. Tucker.
Physical Society, at 3 p.m.—*Annual General Meeting. On the Limit of Refraction in Relation to Temperature and Chemical Composition;* Mr. T. Pelham Dale.

Friday, *Feb.* 10.—Royal Institution, at 9 p.m.—*Safety Lamps in Collieries;* Mr. W. H. Preece.
Royal United Service Institution, at 3 p.m.—*The Practical Value of the Kriegspiel;* Captain H. Spencer Wilkinson.

Saturday, *Feb.* 11.—Royal Institution, at 3 p.m.—*Experimental Optics;* Lord Rayleigh.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. Morgan, Chemical Engineer, Gloucester.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased; Ambers fitted.—W. George, 324, Essex-road, Islington, London.

Trouser Lengths, 5s. Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—Hewitt, 27, Winfield, Leeds.

Minerals or Fossils, Carboniferous or Lias.—12 named specimens, 2s. 6d., free.—C. Wardingley, 30, Blackwood-crescent, Edinburgh.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, Henric, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. —1 stamp.—Address, Henric, 234, Great Colmore-street, Birmingham.

Castings, Parts, Materials, and Finished Models.—Catalogue, 2d.—Butler Bros., 44, Elsden-road, Tottenham, London.

Mesmerism.—"This book is a very good one. Any one can learn the art from it."—*Weekly Budget.* 2s. 6d.—W. Thomas, 22, Clarendon-road, Anfield, Liverpool.

"Playground of Science," just ready, containing novel, simple, and interesting scientific experiments, illustrated. One Shilling, post free.—Truslove and Shirley, 7, St. Paul's-churchyard, London.

Crayon Sketch from any photograph (returned uninjured), correct likeness, 15 by 11, 1s. each. Postage of one or more, 2d.—Mr. Coulthard, Bathwick, Bath.

Mechanics' Specialities.—20 large sheets fretwork patterns, 7d.; 200 turning patterns, 1s.; 300 stencils, 1s.—Below.

Fifty Conjuring Tricks, 1s.; 100 experiments, 1s.; photographs 100 eminent women, 1s.—Collins, Summerlays-place, Bath.

Microscope Objects, mounted, 5s. a dozen. List, approval. Twelve brilliant exhibition objects, unmounted, 1s. 6d.—Henry Ebbige, Framlingham.

Fretwork Carving.—Catalogue of all requisites and 500 miniature designs free, 6 stamps. Harger Bros., Settle.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—Butler Bros., 44, Elsden-road, Tottenham, London.

BOOKS RECEIVED.

Proceedings of the Institution of Mechanical Engineers. August.

Proceedings of the Edinburgh Photographic Society.

An Elementary Treatise on Light and Heat. By the Rev. F. W. Aveling, M.A., B.Sc. London: Relfe, Bros. 1887. Price 3s. 6d.

Expansion of Structures by Heat. By John Keilly, late of Indian Public Works and Victorian Railway Departments. London: Crosby, Lockwood and Co.

Sound, Light and Heat. By Mark R. Wright. "Longmans' Elementary Science Manuals." London: Longmans, Green and Co. 1887.

Lectures on Electricity. By Georges Forbes, F.R.S. London: Longmans, Green and Co. 1888. Price 5s.

Journal of Microscopy and Natural Science, and the Journal of the Postal Microscopical Society. Edited by A. Allen. London: Baillière, Tindall and Cox.

Geology as a Branch of Technical Education. By H. M. Cadell, B.Sc., F.R.S.E. Edinburgh: Neill and Co. 1887.

Proceedings of the Institution of Mechanical Engineers. September number.

Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

MR. GOSCHEN'S ABERDEEN SPEECH.—Mr. Goschen's speech at his installation as Lord Rector of the University of Aberdeen must be considered as thoughtful, original, in some points well-timed, but yet alarming. The speaker evades the subjects usually brought into prominence at university gatherings. He pushes on one side, as incapable of decision, the contest between science and the "humanities." He pleads "not for any particular form of study nor for any particular branch of knowledge, but for a temper, an intellectual habit, an altitude of mind which is applicable to every kind of study and every sort of work." He means "the habit of intellectual interest in all that is studied, learnt or done." Applying this principle to commercial training, Mr. Goschen went on to contend that British clerks would be found inferior to their alien rivals, no matter how our systems of education may be improved, unless the said clerks can be brought to feel an interest in their work itself, altogether outside considerations of profit or even of duty. Such an interest, he contended, was felt by Germans engaged in commercial pursuits; but was not felt, or was felt to a less degree, by Britons. If this distinction really exists, it is a serious one: systems of education may be improved, but how can the interest here required be created?

CLERKENWELL AND THE PUBLIC LIBRARIES' ACT.—Notwithstanding the success of the libraries established under this Act in not a few provincial towns, the attempts at its adoption in London parishes have met with the most obstinate opposition. In Clerkenwell a poll of the ratepayers seems to have resulted in favour of the Act, but the opponents have issued placards alleging that the poll was conducted in an illegal manner, and calling upon the local authorities not to act upon the result of the poll. It does not appear what interests or parties are conducting this movement, nor whether their motive is economy or an objection to this particular expenditure of public money.

OBITUARY NOTICES.—We regret having to put on record the death of Asa Gray, of Harvard University, well known as the greatest American botanist. He was born in 1810, and graduated in medicine, but never practised as a physician, devoting himself entirely to botany. He was an intimate friend of Darwin and of Sir Joseph Hooker, and was one of the earliest converts to Evolution, and its ablest champion in America in opposition to Agassiz and his school. He was a Fellow of the Royal and Linnean Societies, a corresponding member of the French Academy of Sciences, a Regent of the Smithsonian Institution, and filled the office of President of the American Association for the Advancement of Science at its California meeting. Some idea may be formed of the extent of his researches when we mention that the mere titles of his original contributions to science occupy seven columns in the great catalogue compiled by the Royal Society.

ANTON DE BARY, for many years Professor of Botany at the University of Strassburg, died on the 19th of January after a painful illness. The deceased was born in 1831

and studied under Alexander Braun, at Berlin. He became early eminent as an original and successful inquirer, and held in succession the Botanical chairs at Freiburg, Halle, and Strassburg. Since 1867 he has edited the *Botanische Zeitung*. His attention was mainly, perhaps, turned to the *fungi*, upon whose life-history he has thrown a new light, both theoretically and practically. His masterly researches on the potato-disease first saw the light in 1861. He subsequently proved that the *accidium* of the barberry is one particular stage in the development of the *puccinia* of wheat-rust. His grand work, "Morphologie and Physiologie der Pilze, Flechten und Myxomyceten" appeared in 1866, and must be considered merely a fraction of his labours.

On February 1st died Dr. John Thomas Irvine Boswell, another of the foremost botanists of the time. He was for many years curator to the Botanical Society of London, and occupied the chair of Botany at the Charing Cross and at the Middlesex Schools of Medicine. He re-wrote Sowerby's great work on Botany, in twenty volumes, a task which occupied him for as many years.

THE NON-POISONOUS CHARACTER OF NICKEL. — There seems little, if any, reason to object to the use of nickel in cooking utensils. Van Hamel Roos gave a dog in the course of 34 days 255 grains of acetate of nickel, without any injury being occasioned to the animal. It was afterwards killed, and the liver and kidneys—the parts where mineral poisons are especially apt to accumulate were carefully analysed. The quantity of nickel found in them was too small to be determined. The only point to be insisted on is that nickel articles which have to come in contact with food should be perfectly free from arsenic.

SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

THE writer of the interesting essay on "Will-o'-the-wisp," which appeared in Nos. 1, 2, and 3 of this magazine, says, in conclusion, that "in all probability several distinct phenomena have been confounded under the name of *ignis fatuus*, and careful observation is needed for their respective discrimination." I fully agree with him, one reason being that my own experience differs considerably from all the accounts he quotes, while these differ so widely from each other.

In the course of a long walk through Italy, from the Alps to Calabria, I was benighted near Pietra Santa on my way between Carrara and Lucca. Was told that I should find an *osteria* a mile further on, and after walking about four miles saw before me the lights of what I supposed to be a village in the distance. I walked on quite a mile further with the lights of the village still before me, but no nearer. Then I halted, and soon perceived that the apparently distant lights were but twenty or thirty yards ahead, and were faint and fluctuating. I at once understood the illusion, examined it carefully, and then discovered that whichever way I turned the shivering phantoms were before me, and equidistant in every direction. I was evidently surrounded by an undulating phosphorescent atmosphere. My theory of the uniform apparent distance of the waving luminosity is that the light was too faint to be visible unless its thickness in the line of vision became considerable; as I have since learned by experiment that half a dozen equal flames placed behind each other shine through each other, giving six times as much light as either one, *i.e.*, they are transparent to their own radiations and thus present the sum of their luminosities, not by the increased brilliancy of the light nearest to the eye, but by the luminosity of the whole. Thus a flame too faint to be visibly luminous, if but one foot deep, might become visible with a thickness of twenty feet.

This experience illustrates rather strikingly the power of the imagination in shaping such phantoms. I was eagerly looking for the lighted windows of the promised inn, and will-o'-the-wisp accordingly assumed the expected shape. Had I believed in the popular tradition I should probably have seen the lanthorn of the jeering imp, or any other expected luminosity, the actual phosphorescence being sufficiently weird, indefinite, and uncanny to suggest anything.

At last I reached the little town of Viareggio, where I learned that I had taken a wrong turning, and had walked some five miles over the Maremma. On retracing this distance next morning I learned that this Maremma is a perfectly flat monotonous marsh, planted with rice, and then covered with a thin layer of water. The road being broad, straight, and well built, I had kept it safely. This wide expanse of uniform marsh explained the complete uniform surrounding of the phantom lights.

The date was 30th November, which I mention, as much must depend upon the season. In this case the rotting of rice-stems left behind from the recent harvest was in full progress, and probably had much to do with the luminous atmosphere. I need scarcely add that the region is most pestiferous, the malaria being commonly fatal to those who pass a night there in the summer time.

The Duke of Argyll has been very severely handled in the course of his controversy with the geologists in "Nature." He cannot complain of any "conspiracy of silence" in reference to himself. The outspeaking has been very plain indeed. Mr. J. W. Judd, for example, says in reference to the statements which the Duke refuses to retract, "These charges have each and all of them been shown to be absolutely destitute of foundation. The Duke of Argyll must judge for himself if the principle of *noblesse oblige* should not lead him not only to *retract* the charges, but also to *apologise* for having made them. But his Grace may rest assured that, until he does so, the ground for the deep indignation at his conduct, which is so strongly felt both at home and abroad, will still remain."

Reviewing the whole controversy, without leaning to either side, it appears to me that the Duke of Argyle had some grounds for complaining of "silence," but has failed to show any evidence of "conspiracy." There has been no conspiracy, nor deliberate "malice aforethought," in ignoring Mr. Murray's researches on the coral reefs. It is a libel on men of science to assume the probability of such conspiracy; but still there is a good deal of human nature even in the scientific world, and official human nature remains more or less official in spite of science. There are Bumbles even among the "Fellows" at

Burlington House. They never *conspire* to ignore anybody or anything, but the history of science sadly proves that they sometimes refuse to be taught by outsiders, especially by humble aspirants who dare to bring forth any theory in advance of that which has been officially accepted.

As an example, I refer to the history of that greatest triumph of scientific deduction—perhaps the greatest on record—which predicted hypothetically the existence of the planet Neptune. Nobody accuses the Astronomer Royal of conspiring to bury in silence the communication he had received from the young and then unknown mathematician, but when we contrast the conduct of our official astronomer with that of Dr. Galle, of the Royal Observatory of Berlin, we are forced to conclude that had there been more scientific ardour and less Bumbleism at Greenwich, the merit of the discovery of the new planet would have belonged to Adams and England.

Adams commenced his calculations in 1843. In October, 1845, he had finished them, and called at the Royal Observatory, Greenwich, and there left his paper, which assigned the position of the hypothetical planet for October 1st, 1845, and indicated its subsequent course.

On 10th November, 1845, Le Verrier communicated to the Academy of Sciences an account of the *first part* of his calculations; on 1st June, 1846, *the second part*; and on 31st August, 1846, *the third part*. On the 18th September, he sent to the Royal Observatory of Berlin a communication similar to that which Adams had left at our Royal Observatory in October of the previous year. The results of these communications were curiously different.

Dr. Galle at once sought for the planet at the predicted place, and as Sir John Herschel says, "*on that very night actually found it*," only forty-seven minutes of a degree distant from the place assigned to it by the means of the calculations of Adams and Le Verrier. There was no good reason, outside of Bumbledom why this discovery should not have been made at our national and liberally endowed Observatory ten months earlier.

CHINESE KITES.—II.

(*Continued from p.* 100.)

IN our last number we gave some examples of Chinese kites, and we now illustrate the most curious of all these devices, the "Dragon Kite" (Fig. 4). This toy consists of a series of small, very light elliptical discs, covered with Chinese paper. These discs are connected by two strings, which keep them at equal distances. A transverse rod of bamboo is fixed in the major axis of the ellipses, and extends slightly beyond it. To each of its ends is fixed the stalk of a graminaceous plant, which serves to maintain the equilibrium. The front disc has its surface slightly convex, and it is formed into a fantastic face with two small mirrors to serve as eyes. The discs decrease progressively, as shown in Fig. 4, and they are inclined to the wind at an angle of about 45 degs. The entire train takes an undulatory form, recalling the aspect of a serpent creeping. The hindmost disc is fitted with two small streamers, forming the tail of this strange kite.

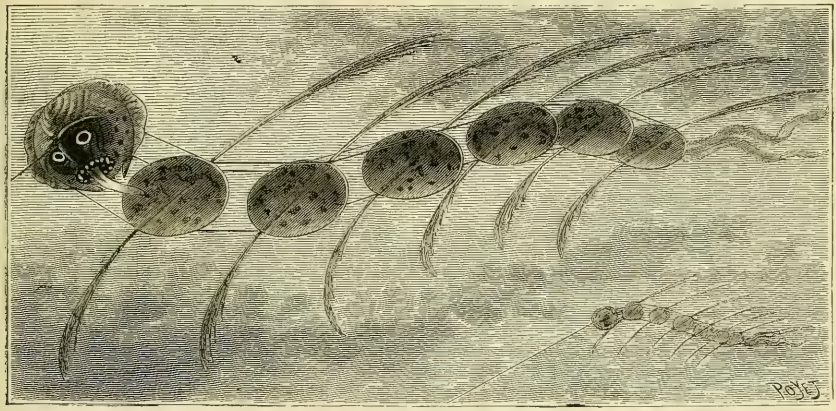


FIG. 4. CHINESE DRAGON KITE.

Much skill is required in sending up this strange kite The Chinese excel in its management, but Europeans succeed in it with difficulty.

ATOMS AND MOLECULES.

AN atom, in the language of chemistry, is the smallest particle of matter that can exist in combination. A molecule is the smallest particle of matter that can have a separate existence. Most molecules are supposed to consist of at least two atoms. Bodies are composed of molecules, and molecules of atoms, as sentences are composed of words, and words of letters, the letters being indivisible. We can cut a lump of salt into halves, quarters, eighths, sixteenths, and so on until we cannot cut it again, we can grind it to powder, but the smallest visible grain will contain millions of millions of molecules. Some idea of the size of the ultimate particles, may be given by imagining one of the smallest visible grains of salt, measuring about a thousandth of an inch

or one thousand millionth of a cubic inch, to be dissolved in a cubic mile of water. One drop of the solution would contain one molecule of salt, if the mixture were well stirred up! If, as Sir W. Thomson suggests, we imagine a drop to be magnified to the size of the world, the molecules would appear from half an inch to two inches in diameter. Or we may imagine the grain to be dissolved in a wineglassful of water, say three ounces; take a drop of this and put it in another wineglass, and fill it up with water; take a drop of this and repeat the operation until we have five glasses; a drop from the fifth glass may be imagined to contain about ten molecules of salt. One of these molecules might be divided by chemical or electrical means, but the halves would no longer be salt: one would be sodium, and the other chlorine. These statements are given before the following figures, because the latter fail to convey any impression to the mind, while the former may perhaps give some faint idea of the size of a molecule.

From a number of different arguments it is believed that the size of a molecule is about one 400,000,000th of an inch, and that there are about 64,000,000,000,000,000,000,000,000 to a cubic inch of solid matter, and about 300,000,000,000,000,000,000 to a cubic inch of air. This seems to be a marvellously small size, but it is merely small in comparison with our usual standard of measurement—an inch. The present writer's pulse has beaten about 1,200,000,000 times; this number is large merely because his lifetime has been long compared with a pulse beat. When we have to deal with measurements of quantities which differ very greatly from the unit of measurement it is convenient to express the number by giving the first digits, or significant figures, and then to indicate how many cyphers there are by powers of ten—thus 3×10 is the number of molecules in a cubic inch of air.

Not only is a lump of salt composed of molecules of salt, which are in turn made of two atoms—one sodium and the other chlorine—but every substance which we can touch, see, taste, or smell is composed of molecules, and most of these are composed of at least two atoms. The theory of divisibility is very old. Lucretius wrote a remarkable poem on "The Nature of Things." Part of it treats of atoms, and contains several statements which are in perfect accordance with the latest discoveries, though the "atoms" of Lucretius are physical, not chemical, and must be looked upon as chemical molecules.

One of the earliest estimates of the size of a molecule was arrived at by Cauchy, the French mathematician. He was investigating the refraction and dispersion of light, and found that, to account for dispersion or the separation of a beam of light into colours [see SCIENTIFIC NEWS, old series, vol. i. page 86], it was necessary to suppose that the distance between the ultimate particles or the molecules cannot be immeasurably less than the length of a wave of light. Now, the average length of a wave of light is about the 40,000th of an inch. The size of a molecule must be very much smaller than this, for, if it were not, the dispersion would be very much greater than it actually is; on the other hand, for similar reasons, it is probably not less than one 10,000th part of the length of a wave of light—that is, about one 400,000,000th of an inch. Some doubt has been cast upon this calculation, and it is stated that it yields results which are considerably different, but it is given here as one of the first attempts to arrive at the size of a molecule.

Another method is due to the German mathematician, Clausius, who has greatly developed the molecular theory of gases. It is assumed that the molecules are hard, elastic globes, all one size, darting about with a velocity which Dr. Joule has calculated from the weight and pressure of hydrogen to be more than 6,000 feet per second. They are constantly coming in collision with each other, and every particle has on an average 17,700,000,000 collisions per second. In the air the number of collisions for each particle is only about half as great, and the average velocity about one-fourth of that in hydrogen, or seventeen miles per hour. The average length of the distance a molecule will travel between the collisions, or the "mean free path," can easily be calculated from these figures. Imagine a number of molecules side by side, just touching each other, in a row of the length of the mean free path. It can be shown by geometry that eight and a-half times this number is equal to the number of times a gas must be compressed in order that it may be liquefied. It is found that in liquefying gases by submitting them to enormous pressure, assisted by intense cold, that the volume is reduced about 40,000 times. There would therefore be about 40,000 divided by $8\frac{1}{2}$, or 4,700 molecules in the row. The length of the free path has been calculated by several different methods. Taking the figures already given, viz., 6,000 feet per second, and 17,700,000,000 collisions in the same space of time, the length of the free path comes out one 240,000th of an inch; there would therefore be 1,128,000,000 molecules in a row an inch long. This is about one-third of the size found by Cauchy's method. It should be observed that this calculation is one which indicates the smallest probable size of the molecule.

Sir William Thomson has suggested several entirely different methods of calculation, and they are found to give results which agree, not, of course, in actual figures, but in the order of magnitude. The tension of the film of a soap-bubble is about sixteen grains per square inch, and when it is stretched it becomes cooled, just as compressed air is cooled when it is allowed to expand. Sir William Thomson has calculated that, in order to maintain the temperature constant while the film is being stretched, half as much energy must be supplied in the form of heat. Therefore, twenty-four inch grains of work must be done in order to increase the size of a film by one square inch. Now, supposing the film to be stretched to anything like one 25,000,000th of an inch in thickness, the work done on it, both in stretching and in maintaining the temperature, would be sufficient to instantly vaporise it. There is evidently some flaw in the reasoning, and the only way out of the difficulty is to admit that at such an extreme thinness the tension would not be so great, and this decrease in tension would be due to there being only a few molecules in this thickness.

Another method due to Sir W. Thomson depends upon the amount of heat produced by the chemical union of copper and zinc to form brass, and this argument gives one 700,000,000th of an inch as the probable minimum.

Not only is it utterly impossible that we shall ever be able to see molecules by any improvements in microscopes, but if the minutest creature that can be observed were provided with the best possible instrument, in due proportion to its own size, it would hardly be able to see them.

DIAL FOR CHRONOGRAPHS.

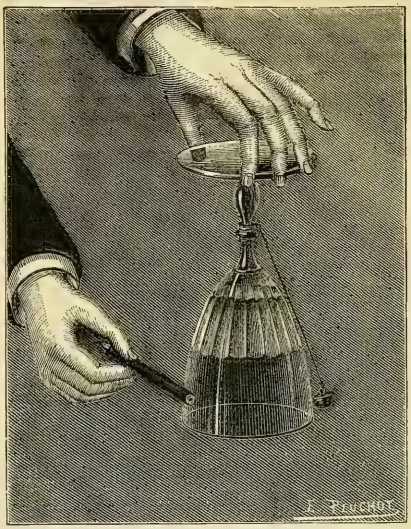
MR. A. P. TROTTER has invented an ingenious dial, which can be used with stop watches to determine the distance of a sound, the space a body falls through, or the rate a train is travelling at. The outermost or first circle on the dial, shown in our illustration, is graduated into seconds and fifths of seconds, as is usual in chronograph dials. The second circle is divided, so as to show the space in feet traversed by a falling body in the interval between the moment of release and the instant of contact with the ground. The third circle also shows this distance when the time is noted between the release of the object and the sound of its impact with the ground. These two circles are only graduated as far as 1,000 feet, as at the end of eight or nine seconds the velocity acquired by a falling body becomes so great that the air resistance sensibly affects the time occupied in falling a certain distance. The fourth circle shows the number of miles per hour a train is travelling, if the second-hand be started when entering upon, and stopped

at the end of, a quarter of a mile. The graduations on the fifth or innermost circle show the distance in miles corresponding to the time between the flash of a gun or of lightning and the arrival of the sound. This dial should prove a valuable addition to stop watches and chronographs.

SOUND WAVES.

IF a stone be thrown in a quiet pool of water, circular waves are seen to start from the spot, which open out as they travel over the surface of the water. A blow on a table with a stick is supposed to cause similar waves in the air, and these vibrations falling upon the drum of the ear produce the sensation to which the name sound has been given.

In the case of a violin-string, the oscillations producing the sound are visible to the eye; the vibrations of a wine-glass are not quite so perceptible, but, as has been pointed out in *La Nature*, they may be made manifest by fastening a boot button to the stem by means of a piece of cotton of such a length that the button nearly reaches the rim of the glass. If the glass is then held in the position shown in our illustration, it can be made to sound by tapping it lightly, when the button will dance



to and fro, thus showing plainly that the surface on which it is resting is in a state of motion.

RATIONAL DEVELOPMENT OF PHOTOGRAPHY.

TO understand the rationale of the scientific development of a photographic dry-plate does not entail much mental labour or ability, and yet, strange to say, many amateurs are quite content to work by a purely "rule of thumb" process. The writers of many of our photographic primers are much to blame in the matter, but the greatest offenders of all are the dry-plate manufacturers themselves, who publish the formulæ best suited to their plates in such a random, unscientific manner, rendering necessary a series of complicated calculations before the desired information can be ascertained. Eight amateurs out of ten will not take the trouble, and consequently all they know about the development of their picture is that "it took so many minims of No. 1 solution, and so many drops of No. 2."

Three chemicals are used principally in development, viz., pyrogallic acid, a bromide either of potash or ammonia, and an alkali. Pyro is the true developer. Before it will do its work, however, it is necessary to render it alkaline. The three alkalies commonly made use of are (1) ammonia, (2) soda, and (3) potash. Potash (in the form of a carbonate, of course,) is perhaps the best to use, as it possesses the good qualities of the other two without their faults. Ammonia is objectionable on account of its volatility, while soda stains the gelatine film yellow. The principal use of the bromide is to retard the action of the developer.

In order, therefore, to mix the developer on scientific

lines, it is necessary first of all to ascertain the normal requirements of the particular brand of plates we may happen to be using. To get at this the manufacturer's formula will have to be analysed. Ascertain how many grains of pyro, how many grains of bromide, and how many minims of ammonia are recommended to each ounce of water. This will be a standard to work by, though of itself not necessarily infallible, and by no means to be trusted implicitly.

Exposure and subject next claim attention before mixing up the developer.

Is the particular plate we are about to develop under or over-exposed? If under-exposed the developer must be weak in pyro and strong in ammonia. If, on the other hand, it has been over-exposed, we shall require more pyro and very little alkali.

In order to learn whether the plate has been correctly exposed or otherwise, it is necessary to submit it first to a tentative development.

The subject has next to be considered. Are there strong contrasts in the subject? If so the developer must be weak in pyro and strong in ammonia. If but little or no contrast, the reverse of this.

Undoubtedly *slow* development is the secret of success. We may develop slowly in two ways, either by using a large proportion of restrainer or a small proportion of alkali. Under no circumstances whatever should the full strength of alkali be given at once, but by judicious increments.

Some few amateurs object to the slow method of development on the grounds of its slightly discolouring the film. The "clearing solution," however, will soon remedy this defect.

Many amateurs fail by using too small a quantity of solution. This is false economy. In order to mix up a developer in accordance with the dictates of our judgment, it is absolutely necessary to keep our chemicals in separate bottles. Ten per cent. solution is by far the best method. Bromide will keep good indefinitely in solution. Not so with ammonia. If the pyro be made up in solution a preservative chemical will have to be added. Sulphite of soda is a great favourite with many for this purpose. To obtain it absolutely pure, however, is a difficult task. Commercial sulphite of soda is largely adulterated, and even the purest soon oxidises. There are two more objections to its use. The first one is, to be effective it is necessary to use it in very large quantities, in the proportions of four of sulphite to one of pyro; and, in the next place, it is alkaline and needs neutralisation.

Meta-bisulphite of soda is free, however, from all these objections, and its use to many amateurs seems entirely unknown. It is used weight for weight with pyro, preserves the solution effectively, is not liable to oxidisation, is of itself acid, and therefore requires no citric or other acid to remove its alkaline reaction. The resulting negative, too, is beautifully clear and remarkably free from stains.

One more question still remains to be answered—How far shall the density be pushed? Is it better to under or over-develope? The least evil of the two is certainly the latter, for a negative can be reduced, but development, once ceased, no further detail can be added.

The proper standard density can only be learnt by experience. It should consist of fine gradations. All desirable detail should be developed up to printing strength, and no further.

THE MUTUAL RELATIONS OF THE SENSES.

IT has been commonly supposed that if one or more of the senses of a man is wanting, or is temporarily in an inactive condition, the others, as if by way of compensation, become increasingly active, and assume a part of the duties of those that are missing. Thus we frequently hear how the blind acquire such a delicacy of touch and hearing that through them they can derive much of the information which normal persons obtain through the medium of eyesight. Nor can we wonder that such should be the case. Without inquiring whether the auditory organs of a blind man receive an unusual amount of nervous energy, we can very well understand that he will attend closely to the sound-waves which reach his ears, and by careful comparison he can form a fairly accurate notion of the position and the distance of solid bodies, such as objects of furniture in a room, or walls and houses in a street.

But we find also cases where the organs of one sense seem to assist those of another in the discharge of their respective functions. Thus it is a well-known fact that the most experienced wine-tasters find themselves quite astray if they attempt to distinguish between different vintages in darkness. Certain experiments on this mutual action of the sense-organs have been made by Dr. Urbanschitsch, of Vienna, and the results which he has reached are most curious. Sensations of hearing for the time being render the sight more acute. Thus the experimentalist placed coloured plates at such a distance that the colours could scarcely be distinguished. If various sounds were then produced, the colours of the plates were recognised more distinctly the higher the pitch of the sounds. Or again, printed matter could be read more clearly in a sparingly illuminated room or at an unusual distance if the ears were simultaneously taking in sounds than in complete silence. In like manner the activity of the eyes, or at least their exposure to light, aids us in the recognition of sounds. Thus the ticking of a watch is more easily heard in the light than in the dark, and if the eyes are open than if they are closed. The various colours of light vary in their effects upon our organs of hearing. Red and green lights seem to strengthen our perceptions of sounds, but blue and yellow lights weaken them. Some musicians, however, to whose judgment Urbanschitsch referred the question, were of opinion that not only red and green, but yellow and blue light intensified sounds by about one-eighth, but violet had a contrary effect.

Corresponding effects were observed in the case of taste and smell. Light in general, and in particular red and green light, heighten their sensitiveness, whilst blue and yellow light, and still more darkness, reduce it. If a person is exposed to red or green light he can taste, not merely with the anterior edges of the tongue, but with its whole surface. Smell and taste reciprocally intensify the perceptions of sounds and sights. There is a curious reciprocal action between the sense of touch and the heat sense, which though they have not distinct organs are certainly not identical. If the skin is tickled with a hair, and the hand is then plunged into hot water, the sensation ceases. If, on the other hand, any part of the body is tickled, and the hand or foot is thrust into cold water the chilly feeling is intensified.

These experiments need to be extended and confirmed, which may be done the more easily as there is no need of any delicate or expensive apparatus.

General Notes.

THE ABYSSINIAN CAMPAIGN.—In a recent number, we referred to the balloons the Italian army is provided with. We now learn that in addition incandescent lamps for signalling at night from them are also being taken out, as well as telephones for communication between the cars and the ground.

ANTARCTIC EXPLORATION.—We regret that the Treasury has not been able to return a favourable reply to the letter addressed by the Colonial Office on behalf of the Australian Colonies for a subsidy towards the expenses of a preliminary cruise in the Antarctic regions for the purposes of scientific and commercial investigations.

TRUNK TELEPHONE LINES FROM LONDON.—We learn that the United and National Telephone Companies intend to lay a heavy copper line to Coventry, whence branches will run to Birmingham, Liverpool and Manchester, and to Nottingham, Sheffield and Leeds. Ultimately it is intended to carry these lines on to the North of England.

CONDITION OF THE THAMES.—From the half-yearly report of the Medical Officer for the port of London, we learn that at the end of June it was impossible to find words adequate to describe the terribly filthy and disgusting state of the water between Greenwich and Erith. A medical contemporary thinks that the deodorisation of the sewage without precipitation is of little use.

BENZINE.—According to the *American Exchange and Review*, hard friction can develop sufficient heat to inflame benzine vapour, especially if the surface rubbed be varnished with shellac. A case is on record of the vapour being ignited by the electricity generated in rubbing a flannel garment which was being cleaned with this fluid.

ELECTRIC TRACTION.—The Electric Traction Company is about to perform experiments on a section of the Metropolitan line with a locomotive of the same power as the present steam locomotives. Should the results prove successful in efficiency and economy, the Electric Traction Company will have the option of working the Metropolitan line electrically for five years; the rate not to be in excess of the present cost of working by steam.

DOMESTIC STEAM EXPLOSIONS.—The Chief Engineer of the Manchester Steam Users Association writes to the *Times* to point out the dangers due to kitchen boilers not being fitted with safety-valves. In one year forty such explosions occurred within twelve days' time, killing nine persons and injuring twenty-seven others. He recommends a small dead-weight safety-valve on which there is no patent-right, and which may be had for half-a-guinea.

SUBMARINE EARTHQUAKE.—On October 21st last a peculiar phenomenon was observed at Port Sandwich, in Mallicolo Island. In the harbour a column of water was projected up into the air, followed by an emission of flames which lighted up the sea and the shore for some distance round. The flames are said to have proceeded from a spot where ships are usually moored. Soundings were made afterwards but no change in the depth of the sea was discovered.

THE END OF THE WORLD.—It may, perhaps, be scarcely believed that Wednesday, the 13th ult., was passed in a state of abject terror by many of the inhabitants of Birmingham. A local astrologer had predicted a series of catastrophes in consequence of the conjunction of Mars and Uranus in the 18th degree of Libra, together with an evil aspect of Mercury, and had kindly advertised his conclusions in the papers. The question is raised whether his object was a practical joke or to test the notion of "liberty enlightening the world."

THE WEATHER IN FRANCE.—The week from January 12th to 18th was frosty but sunny. On the 12th and 13th the thermometer did not fall to 32° Fahr. Since the 14th it has frozen daily with morning temperature of 28½° to 17° F. On the 9th of January the temperature at Harparanda marked 22° F., whilst at Perpignan it rose on the 9th and 10th to 64° F. On the 6th a slight shock of an earthquake was felt at Boufarik, and in the neighbourhood of Algiers.

USE OF RAPHIDES.—From experiments made by Herr Stahl, it appears that the crystalline needles or *raphides* met with in the cells of some plants in large quantity are secreted as a protection against being eaten by animals. Many animals avoid plants with raphides, or eat them only under compulsion. The burning taste of many plants—*e.g.*, *Arum maculatum*—is due to the raphides, as, if the juice be freed from them by filtration, it has quite a mild taste.

WARMING RAILWAY CARRIAGES.—Owing to the recent law passed in consequence of the number of fatalities caused in the United States by the use of stoves in railway carriages, experiments are being made with the view of adopting steam as the source of heat. On the New York Central line a two-inch pipe is fixed under each carriage, communicating with two pipes running the length of the car, with branches under each seat, the main pipes being connected together by flexible tubing.

COMMUNICATIONS WITH LIGHTSHIPS.—We have twice referred to the petitions presented from various towns along our coasts, asking for communication between lightships and the shore. We are now glad to inform our readers that the Board of Trade have stated that experiments are to be made over a period of eighteen months with an electric cable between one of the Goodwin Sands lightships and the shore. If then the experiments are found to be successful, cables will be laid between the shore and lightships in dangerous positions.

FURTHER DISCOVERY OF GOLD IN WALES.—It has been announced that another valuable discovery of gold has been made a few miles distant from the scene of the recent discovery by Mr. Prichard Morgan at Dolgelly. A large number of miners are engaged excavating the mountain, and a quantity of gold-bearing quartz has been sent to London for the purpose of analysis. Prospectors are also making careful search of other mountain ranges in North Wales.

AN EXTRAORDINARY WHIRLWIND.—About twelve o'clock on the night of the 27th ult., a whirlwind in

Grange Road, Jarrow, caught a conveyance in which were three men. The horse and carriage were thrown down by the violence of the wind, one passenger was carried for about 150 yards, the other was thrown against some iron railings, to which he clung, and the driver was blown against a door in Gray-street. The seat of the conveyance was found in Perry-street, and the rug in Boddle-street, some 250 yards away. The storm lasted about a minute.

THE EXTIRPATION OF RABBITS.—It appears that M. Pasteur's proposed plan for combating the rabbit plague in Australia has been tried experimentally with complete success. An enclosed field near Rheims was selected, which was full of burrows, and where guns and ferrets had been employed in vain. M. Loir, a nephew of M. Pasteur, poured upon a truss of hay some broth containing a "cultivation" of the micro-organism of poultry-cholera. The next day nineteen dead rabbits were found, and twelve more a day or two later. Whole families of dead rabbits were found in some of the burrows, and not a living rabbit has since been seen.

NEW TEXTILE MATERIALS.—According to the *Horticultural Times*, the position so long occupied by some of our well-known textile plants, such as hemp, flax, cotton, etc., as well as by silk and wool, is now dangerously threatened by such new materials as are furnished by abacá, aloe, ramié, pineapple, and rheea. The danger to silk production—a process difficult in itself, and dependent on a delicate insect—may be estimated when pitted against a plant which can be cultivated with ease, which grows abundantly in tropical zones, and more especially in Cuba and the Philippines. Rheea, in like manner, is challenging wool, and ramié throws down the gauntlet to cotton.

MR. EDISON ON THE LABOUR QUESTION.—The celebrated electrician, being interviewed by a newspaper reporter, expressed the opinion that the labour question would be ultimately solved by mechanical inventions. He considered that when motive power has become four times as cheap as it is the labouring man will be enriched by it. A hand-worker can, he said, buy four times as much with ten hours of work as his father could fifty years ago. In another generation, he believes that the unskilled labourer, if sober and industrious, can have a house of his own and a horse and carriage (!) and a library and a piano. It is only terrible stupidity that leads some labouring men to suppose that machinery is their foe. It is the thing that gives them independence and freedom.

THE KEW BULLETIN FOR 1887.—This periodical bulletin is devoted to the spread of useful information on the cultivation of economic plants in all parts of the Empire. The director, Mr. W. T. Thiselton Dyer, hopes that it will prove of service to the general public interested in agriculture. There are few vegetable products of value which cannot be cultivated as well in some part of the Empire as in their native soil. Hence the Kew Gardens are becoming the central botanical exchange of the Empire. Questions, especially on the cultivation of and trade in fruits, are being sent round to all the Colonies. On the other hand, the Colonies are now urged to send in samples of their less-known products, that their possible uses may be ascertained.

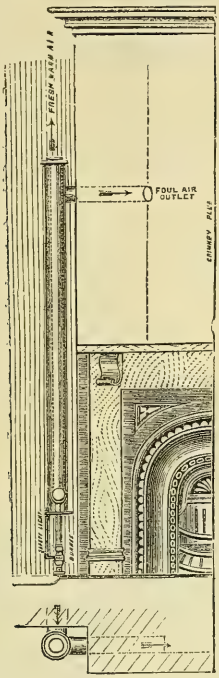
WATER SUPPLY OF LONDON.—Professor Bonney recently delivered at Toynbee Hall a lecture on the "Water Supply of London." The lecturer disclaimed any attempt at sensationalism, and declared that according to his experience the water supply of London was about as good as it well could be. He considered that when contamination did occur it was frequently the fault of the consumer. He forgot, however, to add here that when the supply is constant and when cisterns are consequently superseded, the consumer cannot contaminate the water. He maintained that a good drinking water should not contain more than 50 grains per gallon of solid matter in solution, and that it should be free from colour, taste and smell. He seemed to favour a double supply system, one for dietetic purposes and the other for street watering, the fire service, etc., though he admitted that this arrangement would be costly. He suggested that ultimately a supply of water would have to be obtained from North Wales.

BRISTOL.— Professor Ryan commenced a series of popular lectures upon the steam engine in the Athenæum Hall, on the 19th ult. In the first lecture, after dwelling on the importance of the steam engine and its manifold applications, the lecturer briefly described certain of the more important properties of steam, illustrating his remarks by several interesting experiments. A miniature boiler explosion forcibly exemplified the expansive power of steam, and the collapse of a large tin cube when a partial vacuum was created within it, by the condensation of the contained steam, proved very conclusively the existence of atmospheric pressure. Commencing to review the history of his subject, Dr. Ryan exhibited models of some of the early reaction-engines, amongst them a reaction-locomotive, constructed on the plan originally devised by Sir Isaac Newton. From these early types the lecturer traced the gradual development of the steam-engine down to the time of Watt, his description of the various improvements wrought by successive inventors being assisted by limelight illustrations.

PERPETUAL MOTION.—Professor Hele Shaw, of University College, has recently delivered, in St. George's Hall, Liverpool, a lecture on this ancient but still surviving delusion. It was first proposed, he tells us, in the "Siddhânta Ciromani," a Sanskrit work on astronomy, and was entertained in the thirteenth century by De Honecourt, subsequently by Leonardo da Vinci, Dr. Dirks, Schott, and others. A machine contrived by a Linlithgow shoemaker actually imposed for a time upon Sir David Brewster. Professor Shaw points out that the various perpetual-motion machines have all been openly unsuccessful or fraudulent. Still, during the last twenty years, more than 100 patents for perpetual-motion machines have been taken out in England and France. The speaker then went on to show that perpetual motion involves the impossibility of creating or destroying energy at will. Friction cannot be avoided, and it is well for us that it cannot. Professor Hele Shaw then went on to show that even the motion of the heavenly bodies is not perpetual unless, indeed, as Siemens and others have conjectured, the energy which is now dissipating itself over the expanse of the universe is in some unknown manner again collected together.

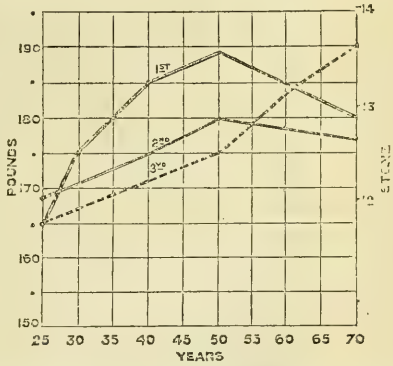
THERMIC VENTILATOR.

THE desideratum in ventilation is that the aerial contents of a room should be in continual and regular motion of displacement and renewal, the renewal taking place at the rate of at least 2,000 cubic feet per hour for every occupant. The displacement should also be so conducted that no current should be felt, and that a uniform temperature should be maintained, while at the same time it is completely under control. With these principles in view, Mr. Lawson Tait, the well-known surgeon, of Birmingham, has introduced a very simple and efficient little apparatus, which he terms a thermic ventilator, and which can be used instead of an ordinary fire. On referring to the accompanying illustration, it will be seen that there is a vertical tube with a gas burner inserted in its lower end. Inside this tube there is another tube shown in dotted lines, which is open at both ends, the top of the outer tube being closed, and having a horizontal outlet leading into the chimney flue. When the gas-jet is alight the tubes become heated, and a circulation of air is set up through the inner tube, the products of combustion passing off into the chimney flue. In this way the air of the room in which the apparatus is placed is warmed and circulated, while it is not contaminated by the products of combustion. Fresh air can be brought from the outside of the house, or from any convenient spot, and the vitiated air can be removed by means of a suitable outlet. One or more jets of gas can be used, according to the size of the apparatus, and it is roughly calculated that for every cubic foot of gas burned, one thousand cubic feet of fresh air can be drawn into the room, and of course the same quantity will be driven out. The little side burner shown in the illustration is to provide a small flame, which prevents the larger atmospheric flame from being extinguished by a down-draught, and this is a very essential adjunct. The apparatus is made by Messrs. Taunton and Hayward, of Heaneage Street, Birmingham.



WEIGHTS AT DIFFERENT AGES.

THE interesting investigation of Mr. Francis Galton on the record which has been kept by Messrs. Barry, of the weights of their customers for more than a century, was described on page 225 in our December number. The results may be very clearly expressed by a set of curves, and afford a good example of the value of the graphical method for exhibiting the variation of two quantities, and of the relations between different variations. We do not know if Mr. Galton has already plotted these curves; it is, however, probable that he has. In the accompanying table twenty years to an inch are taken on the horizontal scale, and twenty pounds to an inch on the vertical. The effects of good living on the aristocracy at the beginning of the century is shown in a striking manner by the rapid ascent of the first curve.



It is noticeable that during their second quarter century in the second and third period, Messrs. Barry's customers gained weight at the rate of ten pounds in twenty-five years, or a little over half an ounce per month, with remarkable regularity, but the difference in their old age calls for further explanation. No reason is apparent why no one in the second period attained the weight of thirteen stone, but it is very satisfactory to see that in the third period, the constitutions were sound enough at fifty to allow of a steady though rather more rapid increase. It would be very interesting to compare these curves with those of the labouring classes during the same period, and to compare the changes in weight-making with the changes which have been observed in the distribution of wealth. It is probable that the weight of the working man would show as favourable changes during the century, as are found among the leisured classes, but in the reverse order.

HAYA POISON.

FOR some time past chemists have been paying some attention to the arrow poisons which are used by the native tribes of Africa. Messrs. T. Christy and Co., the well-known importers of foreign drugs, lately received from Africa some fragments of arrow points for examination, and they sent them to the eminent toxicologist, Dr. L. Lewin, of Berlin. This chemist has discovered in the fragments a new arrow poison called Haya poison, with wonderful properties. In his report just published Dr. Lewin states that he is of opinion that the substance has been attached to the barb of an arrow, as in some of the furrows he noticed a good deal of iron-mould. When ground to powder it had neither taste nor smell, but readily absorbed moisture from the atmosphere. It was soluble in water. On filtering a solution, there remained a residue containing flint and mica, and having a gloss like mother-of-pearl. About 60 per cent. of a solid substance was extracted by water. The solution of even the smallest particle, when boiled with mineral salts, became yellow. Phosphoric acid yielded from a strong acidulated, aqueous solution of the poison, a flaky precipitate, which, when treated with baryta, yielded a minute quantity of a golden-brown substance, having a decided effect upon the eyes of animals. Having often heard of an arrow poison which produced insensibility, Dr. Lewin made experiments to ascertain whether the Haya poison produced anæsthesia of the cornea of the eye, and he was astonished to notice this effect on several animals. The cessation of local sensation took place later than by the anæsthetic cocaine, whose remarkable properties were lately described in our columns. The insensibility, however, lasted for eight or ten hours in the case of the Haya poison, whereas cocaine deadens the feeling for only three minutes. The application produced a passing irritation on the eye. He injected a concentrated solution of the poison in water into a frog: gradually the pulsations of its heart decreased from 30 to 8 per minute, with paralysis of the extremities. In small dogs the effect was very striking; the respirations after about half an hour, became very rapid, with pauses of short duration; the head began to droop, saliva flowed freely from the mouth; peculiar convulsions followed, during which the head was drawn close up to the body, and the eyes were convulsively closed. When this solution was injected under the skin of a pigeon, it produced constant vomiting, frequent evacuations, protracted breathing, convulsions and death. But when it was given to a pigeon by the beak, even a large dose only produced vomiting and diarrhœa. In the former case half a grain was fatal, in the latter three and a half grains had no fatal effect. Dr. Lewin concludes from his experiments that the Haya poison may safely be classified with the African poisons already known. The effects of it reminded him very much of those he had observed with the poison of the Somali, the so-called Ouabaïo, and the effects of the latter resembled the intoxication produced by the sassy bark, which, thirteen years previously, he had worked upon. It was not, however, known that the sassy bark contained the principles of a local anæsthetic character, like the Haya poison. A solution of one in a thousand of the Haya poison produced a deadening of the feeling in the front part of the eye in cats, dogs, guinea-pigs, and other animals, the pupil remaining unchanged for many hours. When the solution was injected under the skin of a guinea-pig, the insensibility of the part treated was so great that Dr. Lewin was able to cut down as far as the muscles without any discomfort to that most sensitive animal. The quantity supplied to Dr. Lewin by the Messrs. Christy was too small for the continuance of his experiments: but a fresh supply will doubtless enable him to discover some remarkable properties, which may make the Haya poison even more valuable than cocaine for operations in surgery.

THE JET INDUSTRY.

THE neighbourhood of Whitby has long been celebrated for the manufacture of ornaments of jet, the produce of the immediate neighbourhood. This mineral is found in a lower bed of the upper lias formation, and is found from about nine miles south of Whitby to Boulby, and again to about a similar distance to the north. The workings in the cliffs are now almost given up, and the chief supply is now drawn from the Cleveland hills, especially at Hilsdale, near Broughton, where several mines are now open.

There are two varieties of jet, the hard and the soft. The former, which is much preferred, is found in layers, which vary greatly in extent and thickness. The largest known specimen measured 6 feet 4 inches in length, 5 inches in width, and 1½ inch in thickness, the weight being 11 lbs. Hard jet varies in price from 4s. to 21s. per lb., whilst soft jet is worth only from 5s. to 30s. per stone weight. The demand for the soft quality has almost ceased, since certain artificial substitutes have come into use, and a quantity of jet is now imported from Spain. Spanish jet is an inferior article, as it neither bears the action of the weather nor that of friction as well as the English quality.

The jet industry has certainly afforded employment at Whitby since 1598. But it was probably used for ornamental purposes by the Romans. In the flourishing times of the trade the annual yield of the raw material was valued at £20,000, and no fewer than 500 men, women, and children were employed in the Whitby district in the manufacture of jet trinkets. In 1860 the jet-trade of Whitby realised £45,000, which by 1873 had been more than doubled. Now, however, jet, like many other articles of British production, is no longer "in fashion." We may hope, however, that the "fickle goddess" will some day relent and again sanction the use of this mineral.

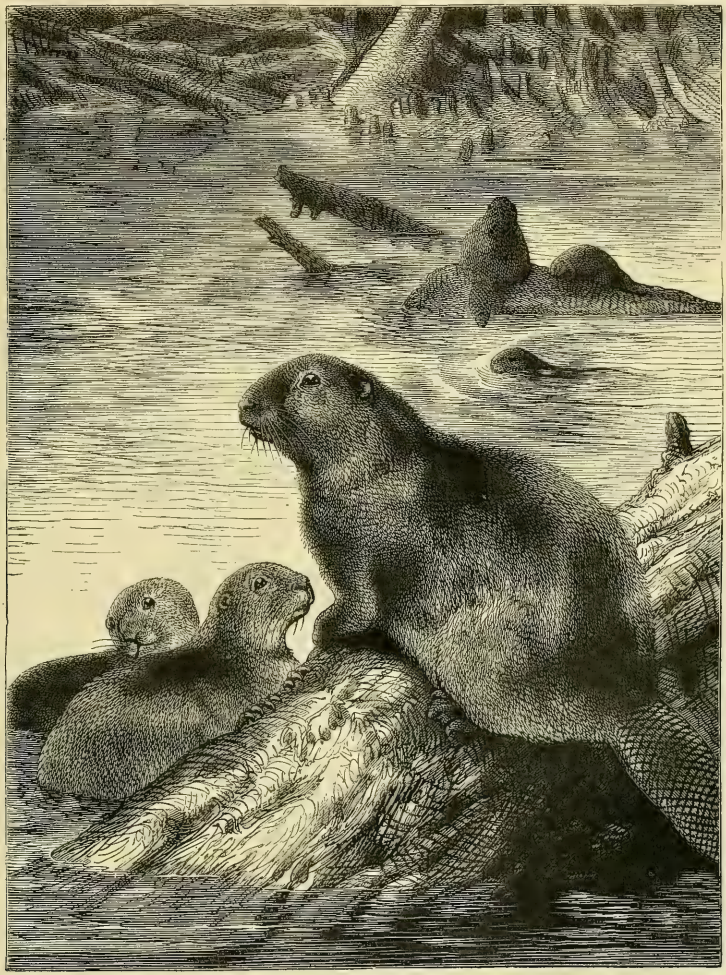
The first step in working jet is generally to remove the outer layer with a chisel. The pieces are then sawn up into sizes according to the articles to be produced. On these pieces the intended pattern is marked with a steel point, the waste portions are cut away, the article brought more exactly to shape by carving, turning, or grinding on emery wheels, and finally polished by friction on list wheels, or boards covered with hide, with the aid of a little rouge.

Concerning the nature and origin of jet, some little controversy has taken place. It is generally, however, supposed to have been in a fluid or semi-fluid state, as sometimes it is found enclosing wood, the scales of fishes, water-worn quartz, pebbles, and even angular fragments of quartz-rock.

Natural History.

BEAVERS AS DAM-BUILDERS.

THE following notes from an old trapper appear in the *Toronto Globe*. He thinks the constructive ability of beavers less wonderful than their skill in choosing the best places for the erection of their dams. These dams are the first requisite of a beaver colony, and serve like a miller's weir for keeping a certain portion of a river always full of water up to a standard depth. No engineer thoroughly versed in their needs and habits could lay out a more suitable place than they do themselves. To those who are well acquainted with their nature this seems the more surprising, since they are not, as popularly represented, the most intelligent of animals, but, on the contrary, they possess less general intelligence than most brutes. If a river has a tributary running into it, and if below the junction, high banks come within a moderate distance of each other, the beavers are sure to dam up such a place. If the high lands widen out looking up-stream, and the valley is level, so as to form long wide flats up both streams, the dam will generally be large, since next to a lake this is their favourite locality.



BEAVERS DAM BUILDING.

In dam-building their skill would put to shame many

of the professional human dam-builders who, in the old times, went about erecting water-mills, and it is not surpassed by man even after the widest and most prolonged experience.

If they intend to raise the level of the water only a few feet they build on the soil under water just as they find it, trusting to their skill in puddling to stop any leak that may occur. If they wish to raise a high dam, such as will probably be found in places like that which the author is describing, they first clear away all rubbish and loose earth, so as to have a firm, clean foundation for their work. Having thus cleaned out the channel they first drag in poles and large branches, laying the thick or butt ends down stream, and as they raise the pile they draw the timber out, so as to form an "apron" below for the water to fall on, and thus prevent it from undermining the dam. The upper part they furnish with finer woodwork than they have used below. After a sufficiency of this material is thus placed in position, they fill it in with earth, which they carry rolled into balls in their arms pressed against their breasts, and they do not desist until they have made the dam water-tight. They are less particular about the wings of the dam extending on each side of the channel and running from the bed of the stream over the flats to the higher grounds. Here they build on the earth as they find it, since here the pressure and force of the water are not nearly so great as in the actual channel of the river. So cleverly can they stop a leak that the trapper has frequently seen a log laid running through a dam under a head of water of three or four feet, and yet scarcely a drop escaping—a task which, as every dam-builder knows, is very difficult. At a job of this kind they use leaves and moss, and push it in almost as firmly as a caulker does in the seams of a vessel. So firm and substantial is their work that their dams are known to keep full of water for years after all the beavers have been killed off. On one occasion the writer saw a dam at the head of a stream where the flow of water in the dry season was so small that evaporation carried it all away, leaving the channel below quite dry, yet the pool above, thanks to the tightness of the dam, was kept constantly full. If the dam is very high, and the foundation not quite satisfactory, they often build one or more smaller dams below, so as to ease the pressure on the main dam above. The trapper remarks that this peculiar skill of the beaver is "one of the things that stagger Darwin in the belief in his own theory." But can any one suggest a better explanation?

Swallows Hybernating.—Mr. John Duncan, of Newcastle-on-Tyne, quotes, doubtingly, the following story:—"An English traveller and his escort, proceeding to Teheran, the modern capital of Persia, in winter, travelled through a pass where there had been an extensive landslip, owing to the frost. Hundreds of swallows, very similar to our British house martins, were found amongst the *debris*. These birds were in a torpid condition, but when taken into the hand, and exposed to the vivifying influence of the camp fire, they all recovered, and, though the weather at the time was severe, most of them rallied and were able to fly away, after being thawed at the fire." Mr. Kerr, of Bacup, writing the same paper, gives, on the authority of a Shrewsbury correspondent, a notice of a torpid swallow which he had found "one winter," and which revived on being warmed. Mr. Duncan asks for particulars of this case, and remarks that several alleged instances of the hybernation of swallows have been recorded, but on being carefully tested they could not be substantiated.

The Senses of Insects.—M. A. Ford (*Recueil Zoolog. Suisse* and *American Naturalist*) gives the following summary of the observations of himself and others. In regard to the *sight* of ants, he finds that they perceive light, and especially the ultra-violet rays; they really *see* these rays, as when without eyes they are almost indifferent to them. On *smell* he concludes that the insects which are essentially guided by sight, as dragon-flies and cicadas, have rudimentary antennæ and little sense of smell. During the night these insects are torpid, and during the day they trust to sight—the cicadas perhaps also to hearing. The organ of smell is situate in the antennæ, especially in those parts where the antennary nerve ramifies. As distinct organs of *taste* Forel regards the nervous terminations on the proboscis of flies, on the jaws, and on the base of the tongue, on the end of the tongue, and on the palate or the epipharynx.

A Whale in the Channel.—The captain and crew of the barge *Frances*, of London, reported at Dover having seen a whale of extraordinary dimensions in the English Channel on Monday, the 30th ult., about eight miles off the South Foreland. The crew of the *Frances*, who were corroborated in their statements by the crew of the *Maud Little*, belonging to Rochester, who also saw the monster, state that their vessel passed within 150 yards. When they first saw it both crews mistook it for the hull of a large vessel which had capsized. The whale measured from 80 to 100 feet in length, and was travelling through the water in an easterly direction, at a good speed, spouting up the water to a distance of about 60 or 70 feet. The fins on the monster's back were about 14 feet above the water.—*Times*.

Winter Diet of Birds.—A correspondent of the *Newcastle Chronicle*, writing from Matfen in Northumberland, states that during the snow-storms at the beginning of January he hung part of the remains of a goose on a currant-bush in the garden, which the blue and the great tits speedily polished to a fine skeleton. The fieldfares, which have been very abundant since November, cleared off the heavy crop of holly-berries, which they preferred to the haws. They have also consumed large quantities of yew berries, which are reputed to be poisonous. Wood-pigeons are plentiful in the turnip fields, but, though they feed upon the leaves and shoots, they do not, as it was formerly suspected, eat the roots. Rooks, however, if pressed for food in severe weather destroy the bulbs.

Post-Glacial Insects.—Mr. Alfred Bell offers some suggestions in the *Entomologist* for January about post-Glacial insects. So far as his experience goes, insect remains are by no means common, and belong chiefly to the Coleoptera. He gives nearly thirty species, nearly all of which belong to this division of the insect world. As Mr. Bell points out, however, it does not follow that Lepidoptera were not present during the post-Glacial period, since they occur in beautiful preservation in deposits of a much older date in England and on the Continent. The nature of the post-Glacial soils was not

favourable to the preservation of soft-bodied animals. "Hence," says Mr. Bell, "If any one knows of Lepidoptera retained in a fossil state, it will be of real service to science if he will say where they were found, and under what conditions."

Influence of Sewage on Herrings.—It is said that the celebrated herrings of Loch Fyne have been driven away or destroyed by the unfortunate scheme of carrying out the sewage mud of Glasgow in ships and discharging it into the Frith of Clyde.

Aquarium in Japan.—The Imperial University has established a marine biological station at Misaki, near Tokio. The laboratory is 48 feet long by 12 to 18 feet wide, and has space for ten workers. Salt water runs constantly into the tanks.

Field Clubs.—Our new contemporary, the *Selborne Magazine*, says, very truthfully:—"Many of the existing field-clubs are mere associations of collectors, who are much more concerned about the individual possession of scarce birds, insects, and wild plants, than the observation of their habits. We intend that Selborne societies for the preservation of rare and beautiful natural objects, and the study of living nature, shall supersede, or better still, absorb these antiquated institutions which owe their origin to the time when the study of natural history consisted almost entirely on 'species making,' and naming."

Notes on the Tarantula.—Herr von Bergsö finds that the nest of this celebrated spider is nearly two feet under-ground. It is approached by a round, smooth tunnel which descends vertically for a foot, then takes a sharp turn and descends for about another foot. The eggs are enclosed in a spun bag, and the young appear in autumn, but cling to the body of the mother until April, the whole family fasting in the meantime. The supposition that the bite of this animal occasions an irresistible tendency to dance is a mere superstition.—*Journal of Microscopy.*

Butterflies of the French Pyrenees.—Mr. H. J. Elwes, F.L.S., in a paper read before the Entomological Society, considers it surprising that a range of mountains so high, so extensive, and so isolated as the Pyrenees should have developed so few distinct forms among the Lepidoptera and should have so large a proportion of those inhabiting the Alps, which seem so completely separated from the Pyrenees by the great plains and low, dry hills of Southern France. Such is not the case among plants, of which there is, he thinks, a very much larger proportion of peculiar species in the Pyrenees; whilst a much greater number of common Swiss plants are absent.

THE NORWEGIAN FISHERIES.

It is an established fact that fisheries are more productive in those parts of the ocean which lie in or near the frigid zones than they are in warmer regions. The causes of this superiority are various. The most prolific food-fishes, such as the herring and the cod, seem to prefer cold waters. In warm or even mild seas many species of fishes are occasionally or even normally unwholesome. Further, in such climates there is always a risk of a great part of the take having to be thrown away in consequence of prompt decomposition. Hence it is found that as far as the northern hemisphere is concerned the most important fisheries are those of Norway, of Newfoundland and the neighbouring coasts, and of British Columbia, with Alaska.

The seas of southern Norway are well known as yielding a large supply of lobsters, and many of the rivers throughout the country are famous localities for salmon. They swarm, too, with eels, which sometimes, when undertaking one of their periodical pilgrimages, come down in such number as to clog the wheels of water-mills. But the average Norseman, of whatever station in life, regards eels with a superstitious horror, as beings closely connected with witches, trolls, and all that is uncanny. Hence he will neither eat eels himself nor even catch them for exportation to less scrupulous nations. It is remarkable that a very similar feeling prevails in Scotland, and that thus, in both countries, a large quantity of food is allowed to go to waste.

It is in northern Norway, however, that the fisheries are of the greatest national and commercial importance. Here there are practically no manufactures, and the climate joined to the rocky character of the land confines agriculture within very narrow limits. Hence the inhabitants are in a manner forced to draw their support from the ocean. In the seas among the Lofotens and along the coast of Finmarken lobsters are not found, mackerel are also very rare, but the cod and the herring are found in millions. Halibut are also plentiful, and reach here their largest size. But they do not form the subject of any expensive export trade, since in the south of England at least a mistaken prejudice regards them as inferior to cod.

Among the Lofotens the great swarm of cod make their appearance in January, and fishing begins in good earnest. Multitudes of men, who follow other occupations in the remainder of the year, flock to these islands, and carry on the pursuit amidst tempests and darkness; obstacles which are here encountered without limit. Perhaps there are in the world no seas stormier than these which wash the northern coasts of Norway. So violent are the tempests that the fishermen's huts along the shore are sometimes swept away, and the men out in their boats very frequently lose their nets and even their lives. So numerous are the fishes, and so eager to be caught, that they will bite at a naked hook. In a favourable season the number of cod caught among the Lofotens exceeds thirty millions. But the seasons are occasionally bad from two causes. The fish may be comparatively scarce, or the weather so rough that the boats cannot venture out. In such seasons the distress experienced is fearful.

The fish caught are utilised chiefly in three ways. A vast number are salted and dried, and exported to countries where salt fish are in vogue as an article of diet. We may here remark that salt cod has a very low dietetic value. The brine extracts out of the tissues a large proportion of the phosphates present.

The Norwegians of the lower classes are by no means scrupulous as to the condition of the fish which they consume. This carelessness is by some suspected to be one of the causes, if not the main cause, why leprosy still exists in Norway. It has been contended that this fearful disease, though no respecter of climate, is con-

fined to regions where fish of doubtful quality forms an important part of the food of the inhabitants. This, however, is a question which we must leave to our medical contemporaries.

A second product of these fisheries is manure. The heads and backbones of all the cods, dried and salted, and the entire bodies of inferior and damaged fishes, are not, as formerly, thrown into the sea, but are collected by small steamers which go round among the fleet of fishing-boats and bring both this refuse and the livers at once to shore. Here the refuse is thrown into malodorous heaps until it can be attended to. For conversion into manure it is dried, pressed strongly to extract a coarse oil, and converted by grinding and sifting into a powder. As there is no one to raise any objection, no complaints are made concerning the somewhat offensive nature of this process, and no deodorising substances are employed.

Judging from its composition, this fish-manure should be about equal in efficacy to Peruvian guano in its earlier days. Like guano, its ultimate source is fish. The only difference is that Peruvian guano has been elaborated in the digestive organs of sea-fowl, while the Norwegian fish-manure has merely been pulverised by machinery.

The third chief product obtained from the fisheries is oil of two main kinds. There is the coarse, brown, evil-smelling oil extracted by strong pressure from refuse fish, and used principally by curriers; and there is the medicinal oil, colourless and scentless, obtained from the livers of the fish.

As regards cod-liver oil, there prevail a few misapprehensions. The oil, as it exists in the cells of the liver, whilst perfectly fresh, is clear and colourless as water, and is capable of being extracted in this state, if taken in hand at once; but if the livers are allowed to lie and enter into decomposition the oil first becomes of a light brown, and then of a dark brown, and at the same time it acquires an acrid, rancid taste.

Here we find an explanation of the superiority of the Norwegian cod-liver oil over that from Newfoundland. The fisheries in the Lofotens are carried on often within half an hour's sail of the land, and thus the livers of the fish find their way to the manufactories before any decomposition has set in, and the oil is drawn in its original colourless, sweet condition. Such oil, it must be admitted, is not always to be had in the retail trade. In the hands of importers and dealers it undergoes certain additions and manipulations, which improve neither its taste nor its medicinal virtues.

The Newfoundland fishing-smacks are often engaged at the distance of a couple of days' sail from the coast, and, as no collecting vessels go round the fleet to receive the livers, these, if they reach land, are already turning rancid. In addition, the extraction of the oil is not conducted as carefully as it is done in Norway. There can be, however, no doubt that the oil from Newfoundland would equal the Norwegian make in quality if the livers were collected with the same promptitude and if the extraction were carried on with the same skill.

About the end of January, or the earlier part of February, the great army of cod-fish leave the Lofotens, and appear at more northern places along the coast, round the North Cape, and into the White Sea. The fishermen follow, and we are told that there exists a floating oil factory, which follows in their track.

It is curious that mosquitoes should be troublesome even on such storm-beaten rocks as the Lofotens.

TRAINED INTELLIGENCE.

THE competition of the present day has been well defined as the competition of trained intelligence, and it may be added that all the outcry which is now being made in connection with technical and commercial education has for its object the promotion of this trained intelligence. There is no scarcity of intelligent workmen in our isles, but the greater number of them are intelligent by nature rather than by training. They have all the knowledge of detail given them by experience and practice, but have little of the knowledge of theory and principle gained by education and scientific training. Much has been said in disparagement of the British workman of all callings and of all grades, and without doubt many of the adverse reflections are in far too many cases well merited. Most of us can recall instances of leaks in roofs caused by men called in to mend them, of drains arranged so as to flood our houses with sewer-gas, of hot-water pipes and boilers admirably calculated to explode violently, and so on. These are the results of the want of trained intelligence, and it is for the avoidance of these blunders that technical training is so persistently advocated. In the meantime we can do nothing but try to promote the cause of industrial education as much as possible, and patiently await the advent of the British workman of the future—the outcome of technical training.

PROPOSED TEACHING UNIVERSITY FOR LONDON.

THE text of the petition to the Queen for the incorporation of a Teaching University for London is now before the public. The principal objects aimed at for the new university are:—

(1) The organization of University teaching in and for London, in the form of a Teaching University, with faculties of arts, science, laws, and medicine.

(2) The association of University examinations with University teaching and the direction of both by the same authorities.

(3) The conferring of a substantive voice in the government of the University upon those engaged in the work of University teaching and examination.

(4) Existing institutions in London of University rank not to be abolished or ignored, but to be taken as the basis or component parts of the University, and either partially or completely incorporated with the *minimum* of internal change.

(5) An alliance to be established between the University and the professional societies or corporations, the Council of Legal Education as representing the Inns of Court, the Royal College of Physicians of London, and the Royal College of Surgeons of England.

The petitioners pray in particular that a University may be constituted in and for London, having power to grant its own degrees in the faculties of arts, science, laws, and medicine, and that your Majesty will be pleased to make such orders in the premises as to your Majesty, in your Royal wisdom and justice, may seem meet.

THE LARGEST DYNAMO.—We learn from *Iron* that what will prove to be the largest dynamo yet built is shortly to be constructed in America for central station electric lighting. It is to have an armature 42 feet in diameter, and an output of 3,000,000 watts.

Reviews.

Short Studies from Nature. By various Authors. Illustrated. London, Paris, New York, and Melbourne: Cassell and Co., Limited.

We have here ten "short studies" by different writers, but it does not appear who has selected either the subjects or the authors. Mr. W. S. Dallas, F.L.S., discourses in a very interesting manner on bats. These animals, it is remarked, like their companions the owls, are looked upon by the general public as uncanny and of evil omen. "Angels of all kinds," we read, "are represented with birds' wings, while those of bats have, by universal consent, always been conferred upon demons." It has, of course, been repeatedly pointed out that, to represent any being supposed to be formed on the human type with wings of any kind attached behind the shoulders is a blunder painful to the eyes of the naturalist.

In their diet bats vary. Some of them, like those of Britain, prey chiefly upon night-flying insects, and are therefore to be welcomed by everyone save the entomologist. But in the Eastern Archipelago, in Australia and South America there are fruit-eating bats, which occasion serious damage in orchards and vineyards, the more as they are endowed with an insatiable appetite. A specimen of the small Indian bat, *Cynopterus marginatus*, has been known to eat in three hours double its own weight of fruit.

A structural peculiarity of the bats appears in the naked membranes about the ears and nose, which seem to be exquisitely sensitive organs of feeling. These appendages are the more highly developed in bats the more decidedly nocturnal are their habits and the darker the retreats which they frequent.

It is an interesting question why the prevailing colours of the bat tribe should be so sombre. Insects which fly in the twilight are often very richly coloured.

Another moot point is why the so-called "vampire" bats should be so greedy for blood. It is evidently not necessary to their existence, and it is highly probable that the ancestors of many can never have had the opportunity of such a feast. Whence, then, this strange craving?

Passing over an essay on "Flame," by Prof. F. R. Eaton Lowe, we find Dr. R. Brown, F.L.S., describing the migrations of birds. This author reminds us that the "mysterious unerring instinct" ascribed to these creatures by the naturalists of the past, and by not a few "unnaturalists" in the present, is a delusion. The vast mortality incurred on these half-yearly journeys proves that the instinct is very erring. Birds do not take a straight line to their destination, but follow rivers, coasts, valleys, etc. We have, however, to deal with the great difficulty that a part of the birds of some species in a given country will migrate while their fellows remain. The robin is migratory in some parts of Germany, but stationary in Britain. It is also mentioned as a curious fact that the nightingale, though not uncommon in the Valley of the Thames, eschews the milder climate of the Channel Islands, West Devon, and South Wales.

Mr. G. C. Chisholm, B.Sc., treats on "Snow." He enlarges on the use of snow as a protection against extreme cold, but he overlooks the fact that it robs the earth of heat in several ways. When watery vapour is turned into snow in the upper regions of the atmosphere, the latent heat of each particle is set free and escapes into space. So long as snow lies the rays of the sun are radiated off, and, as far as this world is concerned, go to waste. And when the snow melts, a vast quantity of heat is rendered latent. It is very possible that were it not for snow in some region from which the winds arrive plants would need no protection.

"Dragon Flies," by Mr. W. S. Dallas, is a pleasing and instructive paper. The author exposes the vulgar errors involved in such synonyms as "horse-stingers" and "devil's darning needles." But we fear he will plead in vain on behalf of these insects, which injure neither our persons nor our crops, and which aid the swallows in ridding the air of flies and gnats.

Passing over, from lack of space, the papers on "Oak-apples" and "Comets," we meet with an account of "Caves," by Mr. James Dallas, curator of the Exeter Museum. Here we are compelled to notice certain errors in point of locality. Fingal's Cave is in the Isle of Staffa, and not "off the coast of Ireland." Kinderscout, with its gritstone cavern, is not in Yorkshire, but in Derbyshire, being, in fact, the highest summit of "The Peak." There is a good illustration of the grotto of Antiparos, but we find no mention of it in the text.

"The Glow Worm," by Mr. G. G. Chisholm, includes a notice of other phosphorescent animals, terrestrial and oceanic. Among the former, the lantern-fly of Guiana (*Fulgora laternaria*) and the candle-fly of China (*Fulgora candelaria*) still remain doubtful.

The concluding memoir on "Minute Organisms," by Mr. F. P. Balknill, treats not of bacteria and micrococci, as might perhaps have been expected, but of the *Foraminifera*.

We must pronounce the joint production of the authors before us a very readable and a highly-instructive book, attributes which we do not always find in combination.

An Elementary Treatise on Light and Heat. By the Rev. F. W. Aveling, M.A., B.Sc. (London: Relfe Bros. 1887. 3s. 6d.)

Mr. Aveling seems to have yielded to one of the chief educational temptations of the day, and added yet another to the many books offering a short cut, not to knowledge, but to such an evanescent imitation of knowledge as may tide a candidate over an examination, and leave him after it very little better than before. If a book like this were made for himself by a student, while experimenting and reading, or if it were used only as an accompaniment to experimental work and fuller reading, there would be great advantage to him in having such a clear epitome of his work as is given by Mr. Aveling; but unfortunately it is so much easier to "get up" the subject from the epitome, and human nature tends so decidedly in the direction of least resistance, that it has become a duty on the part of authors and teachers to refrain, as far as may be, from providing such opportunities. For examinational purposes, Mr. Aveling's book may be highly recommended; for purposes of real education it is little likely to be used.

The Morphology of the Carinae upon the Septa of Rugose Corals. By Mary E. Holmes, A.M Boston: Bradlee Whidden.

This memoir, which has been accepted as a thesis for the degree of Doctor of Philosophy by the University of Michigan, is the outcome of thoroughgoing scientific work. The authoress has, however, selected a subject which lies quite outside the region of popular interest, and which can scarcely be made intelligible save to spe-

cialists. The *Rugosa*, otherwise known as *Tetracoralla*, form an important group among the corals. They are described as appearing like a series of cups, one within another, generally increasing in diameter as they ascend, and surrounded by a wall enclosing the septa. These septa, in some of the genera, present peculiar outgrowths known as carinae, and these Miss Holmes has made the object of especial study. She shows that they are not inorganic structures, casually attached to the septa, but are normal out-growths, though not homologous with any of the structures usually recognised in these beings. She considers that their full functional value has not yet been determined. We next find a description of their structure in upwards of forty species of corals. The treatise is illustrated with thirty-four figures, mostly drawn from nature.

Expansion of Structures by Heat. By John Keilly, late of Indian Public Works and Victorian Railway Departments. (London: Crosby Lockwood and Co.)

This is a useful book for the civil engineer. It commences with simple formulæ and tables of coefficients of expansion, and fully worked-out examples of the expansion of a steel tape, a wrought-iron girder, a wire pendulum, and a lead pipe are given. The effects of the force of expansion are dealt with in a very clear style, and a table is given showing the force exerted in expanding or contracting by a bar one square inch in sectional area for a variation of temperature of one degree, and the variation of temperature required to produce a force of one ton in a bar of this size. It is shown that, when the barrel of a gun becomes heated, the bore does not contract, as stated in some works on musketry, but it expands. "During the late campaign in the Soudan it was found that, after firing, the charge would not enter the barrel of the breech-loader in many instances. This was attributed to the presence of grit from the sand, but it appears probable that another solution can be found for the difficulty. Soldiers' pouches are covered with black glazed leather, and, when exposed to the sun of the Soudan, some of the ammunition in them would be raised to almost as high a temperature as the barrel of the rifle. But the ratio of

$$\frac{\text{the expansion of lead}}{\text{the expansion of iron}} = \frac{0{\cdot}0000162}{0{\cdot}00000686} = 2{\cdot}36$$

—that is to say, for the same variation of temperature the leaden bullet would expand two and a-third times as much as the iron barrel of the rifle; whence, if it be assumed that the machine-made bullets were just a fair fit for the rifles at the temperatures common in England, they would possibly not fit when under different circumstances in the Soudan or in India."

A considerable number of examples throughout the book are worked out in full, figure by figure, but the author deals only with purely civil engineering, where the greatest range of temperature is from 215 degrees in the sun to a few degrees below zero in a hard frost. The mechanical engineer will not find any examples of the effects of expansion in steam boilers, etc., though the tables given will, of course, be equally useful to him. In iron structures—such, for example, as the Crystal Palace—it is only in exceptional cases that special calculations need be made for the strains caused by an unequal distribution of temperature. A short chapter is devoted to a modification of the construction of suspension bridges, which does not appear very feasible even on a moderately large scale. It is proposed that the piers should be attached to the member forming the road, and that the whole bridge, road, piers, chains and all, should be free to expand and contract, presumably on rollers.

Playground of Science: A Series of Novel and Interesting Scientific Experiments. By Johnston Stephen. London: Truslove and Shirley.

The author of this little book evidently aims chiefly at the young, into whom he seeks to instil a taste for experimental science under the guise of amusement. It is his evident hope, and our belief, that he will be not unsuccessful. The experiments which he describes can be performed easily and cheaply, and some of them are of a very novel character. Under the head "Chemical Vegetation," he (the author) gives a process which we saw performed by its discoverer, M. Georges Fournier. The forms produced are certainly much closer imitations of living things than the lead or silver trees, with which young experimentalists are often amused. We find in them, as in plants and animals, vessels or cells whose contents differ in nature from the walls in which they are enclosed. They display, in short, a certain beginning of differentiation. But in what it may end we cannot say. The book will, we think, form a very appropriate present for boys of an inquiring turn of mind, who will draw conclusions from what they see.

THE RATE OF ANIMAL DEVELOPMENT.—I.

ONE of the attempts made to prove the existence of a "great gulf" severing man from the rest of creation is exceptionally curious as an instance alike of bad observation and of hasty reasoning from defective premisses. That by such arguments men of eminence could mislead themselves and succeed for a long time in misleading the public is at once suggestive and humiliating. Professor St. George Mivart suggests ("Lessons from Nature") that a book ought to be written on the "Stupidity of Animals." Should the needful companion volume on the "Stupidity of Mankind" follow in due course, it might very suitably open with the reasoning we are about to quote.

To begin then: The slow bodily development of the human infant, and its prolonged helplessness, are matters far too familiar to require description. No less familiar and generally admitted is the rapidity with which foals, calves, lambs, kids, chickens, and ducklings acquire the use of their limbs and other organs. Such facts could not fail to come under the notice even of very careless observers. But who would have supposed that such characteristics would be, without further scrutiny, at once seized hold of as a fit theme for stilted declamation, and be elevated to the rank of a fundamental distinction between man and beast? Yet this gross error was actually committed, not merely by men of words, "talkers of talk"—which was bad enough—but even by a man of things, like Sir Humphrey Davy! The great chemist, in his "Salmonia," attempts to show that man does not use his limbs instinctively, like other animals. Quoth he, "Man is so constituted that his muscles acquire their power by habit,* but in the colt and the chicken the limbs are formed with the power

* Every one knows that a muscle is strengthened by habit; but if it were originally without power "habit" would be impossible.

of motion, and these animals walk as soon as they have quitted the womb or the egg.

"*Physicus.*—I think I have observed that birds learn to fly and acquire the use of their limbs by continued efforts, in the same manner as a child does that of his limbs.

"*Ornither.*—I cannot agree with you. Young birds cannot fly as soon as they are hatched, because they have no wing-feathers; but as soon as these are developed, and even before they are perfectly strong, they use their wings, fly and quit the nest without any education from their parents."

Very similar assertions may be found in an attempt made by the late Professor Whewell ("Philosophy of the Inductive Sciences") to set aside the plain truth that man, like every other animal, has an instinctive knowledge of the use of his limbs and other voluntary organs. Said the learned professor:—

"The child learns to distinguish forms and positions by a repeated and incessant use of his hands and eyes; he learns to walk, to run, and to leap, by slow and laborious degrees; he distinguishes one man from another, and one animal from another only after repeated mistakes. Nor can we conceive this to be otherwise. How should the child know at once what muscles he is to exert that he may stand and not fall till he has often tried? How should he learn to direct his attention to the differences of different faces and persons till he is roused by some memory, or hope, which implies memory? It seems to me as if the sensations could not, without considerable practice, be rightly referred to ideas of space, force, resemblance, and the like. Yet that which thus appears impossible is, in fact, done by animals. The lamb, almost immediately after its birth, follows its mother, accommodating the action of its muscles to the form of the ground. The chick just emerged from the shell picks up a minute insect, directing its beak with the greatest accuracy. Even the human infant seeks the breast and exerts its muscles in sucking almost as soon as it is born."

So, after all, "that which thus appears impossible" is, in fact, done not by "animals" alone, but by man also! The concession contained in the last sentence is fatal to all that has gone before. The professor ought, by all means, to have asserted that infants learn to suck only "by slow and laborious degrees." It would scarcely have been a more wanton assumption than he has indulged in freely in the course of his argument.

In the same vein as Davy and Whewell, teleologists and rhetoricians, when enlarging upon the marvels of instinct, have seldom failed to trot out the colt, the calf, and the lamb, and to erect upon the precocity of these creatures, as compared with the slow development of our own species, a fancied wall of demarcation between "man and beast." Had they been really actuated by a scientific spirit, they would have felt it their bounden duty, first to ascertain whether *all* the lower animals were, in contrast to man, able to use their limbs at once after birth. Had they done so they might have come upon evidence similar to what is thus given by an eye-witness (A. R. Wallace, "Malay Archipelago"):—

"The mias (orang-utan), like a very young baby, lying on its back quite helpless, rolling lazily from side to side, stretching out all fours into the air, wishing to grasp something, but hardly able to guide its fingers to any definite object; and, when dissatisfied, opening wide its mouth and expressing its wants by an almost infantile scream. . . . When I had had it for about a month it began to exhibit some signs of learning to run alone. When laid upon the floor it would push itself along by its legs, or roll over, and thus make an unwieldy progression. When lying in the box it would lift itself up to the edge into almost an erect position, and once or twice succeeded in tumbling over."

Thus we see that the nearer brutes approach to man the more gradual is their development. The young ape in question was evidently learning the use of its limbs in the same manner as a human child. The process which, in the colt and the lamb is so shortened as to become imperceptible, is here shown at length. That the child makes still more gradual process, especially in the higher races of mankind, is a mere difference of degree.

(*To be continued.*)

THE PROGRESS OF BOTANY IN CALCUTTA.

SURGEON-MAJOR G. KING, the Superintendent of the Royal Botanic Garden, Calcutta, has recently presented his annual report to the Secretary of the Government of Bengal. This being the hundredth annual report, he has deemed it a fitting opportunity for giving a brief history of the Garden. Founded under the advice and guidance of Colonel Robert Kyd, it originally comprised a large collection of exotic plants, chiefly from the Straits. Subsequent superintendents enlarged the original scheme of the work, and did much to further the systematic study of the plants of India. Collecting expeditions were organised, and a botanical survey of a large part of the Indian Empire was undertaken. It was originally intended that the Garden should be a source of botanical information, and a centre to which exotic plants of economic interest could be imported for experimental cultivation, and from which in turn they could be issued for distribution. It was also intended to assist in introducing indigenous Indian products to new markets, and to be not only a botanical, but also a horticultural and agricultural garden. In early days the Garden undoubtedly did service of a negative nature by demonstrating that certain desirable natural products cannot be grown in Bengal. Later the Garden bore an important part in the final establishment of the tea industry in Northern India, and also in initiating and carrying to a successful issue the cultivation of the quinine-yielding cinchonas of the Andes. Under the present superintendent much has been done to repair the ravages of the cyclones in 1864 and 1867, new roads and footpaths have been made, and three new conservatories have been erected. The interchange and distribution of plants and seeds have gone on actively during the year; 8,064 plants have been received, and 46,104 issued; 933 packets of seeds have been received, and 2,534 packets have been distributed. The report shows very clearly the valuable character of the work carried on at the Botanic Garden, Calcutta. It is certainly desirable that such authoritative help should be given to check the needless waste of individual efforts.

VITALITY OF SEEDS.—Two German seedsmen of large experience give eight years as the limit of the vitality of most seeds.

Abstracts of Papers, Lectures, etc.

THE ROYAL INSTITUTION.

On the 21st ult., Lord Raleigh commenced a course of lectures on experimental optics, illustrated by electric light. Beginning with the consideration of the enfeeblement of light by distance it was pointed out that this phenomenon quite harmonised with Sir Isaac Newton's theory, that actual material corpuscles emanated from the source of light and spread in all directions as they travelled. But it also harmonised with Thomas Young's wave or undulatory theory. It was most remarkable to find two theories so totally distinct, each equally supported by the fact of the enfeeblement of light by distance. But when the matter was more closely looked into, it was seen that the coincidence was near. Both assumed a something travelling outwards and spreading, corpuscles in one case and waves in the other—actual matter in the former, energy in the latter. In both cases the enfeeblement would be inversely as the square of the distance travelled. On this law were based the various methods of photometry now practically employed. Count Rumford's now historical method was selected as an illustration of the comparison of two lights, in this case an electric glow light as against a gas jet. The two lights threw a shadow of the same rod on to a screen, the intensity of the shadows varying with the distances of the lights. When the two shadows were equal the distance was ascertained in inches, and the intensity of the two lights thus compared. In this case the ratios worked out—gas, 11·025 ; glow light, 16·900. When two lights were very disproportionate it was, however, more difficult to compare them, and it could not be done with the same accuracy. One form of photometer shown was a revolving perforated disc. The area of perforations and the intensity of the standard were known, and the speed of rotation was measured. When the shadow of a rod from a light to be tested was matched by the shadow from the intermittent light the value of the tested light was at once known. The next subject illustrated was the reflection of light. From such a surface as a white screen the light appeared to be given off independently of how it fell on it. But when a powerful contracted beam was reflected from a highly-polished surface, held obliquely, it was seen that the angle at which it left the mirror was the same as that at which it fell on it. The electric light and a silver mirror such as was used for astronomical purposes showed this with remarkable definition on a large scale. The subject of the "perversion" of a looking-glass, changing right to left, was next considered. Letters or figures written on some transparent substance, and placed in front of a looking-glass, helped to realise that what was seen by reflection was what would be seen directly on the other side of the glass. The amount of light reflected by mirrors was an important consideration. In the astronomical silver mirrors now in use it was about 95 per cent., with speculum metal about 60, and bright steel far less.

ROYAL ASTRONOMICAL SOCIETY.

At the meeting held on the 13th ult., the Rev. Father Perry read a paper on the Condition of the Solar Surface during the year 1887, as observed at Stonyhurst College Observatory. The sun was observed on eleven days in January, eighteen in February, twenty-four in March, twenty-two in April, twenty-two in May, twenty-eight in June, thirty in July, twenty-five in August, twenty-one in September, twenty-three in October, seventeen in November, and eighteen in December, making a total of 259 days.

Mr. E. J. Stone read a paper entitled "Observations of the Moon made at the Radcliffe Observatory, Oxford, during the year 1887, and a Comparison of the Results, with the Tabular Places given by Hansen's Lunar Tables," in which he pointed out that the difference between the observed places and the tabular places had been gradually increasing since 1864, and now amounted to as much as fifteen seconds and eight-tenths. Mr. Stone contended that such a divergence could not be neglected or passed over by altering the constants of the lunar theory. Had a change in the theory been made, and new tables made use of, Neptune would never have been discovered.

Mr. Bryant laid before the meeting a paper on the "Opposition of Sappho," containing an ephemeris for the opposition which takes place next March and April, with a list of comparison stars, of which he asked observers to make use.

The Astronomer Royal, in a paper on the Spectroscopic Observations of the Motion of the Stars in the Line of Sight taken in the year 1887, said there were two points which he thought might be of interest. Sirius had shown a complete reversion of its motion during the time of observation at Greenwich, and since Dr. Huggins's first results. In 1868 Dr. Huggins observed the motion away from us as + 15 miles per second. In 1876 the motion was 21 miles per second away. In subsequent years the following results were obtained + signifying motion away from, and − motion towards the earth :— 1887 + 12, 1878 + 22, 1880 + 16, 1881 + 4½, 1882 + 4, 1883 − 4, 1884 − 21, 1885 − 20, 1886 − 20, 1887 + 6. Last year, therefore, we had come to a small plus motion again. These results must, of course, be accepted with some caution, as the line in the spectrum observed in these observations was always the F line, which was a very broad line in the spectrum of Sirius, and that line had somewhat changed in its character, so that it might be that there had been some change of the absorption which might have affected the place of the line in the spectrum of Sirius, so that the observations really might not indicate a change of radial motion.

Mr. Turner read a paper by Mr. J. R. Hind on "The Path of the Total Solar Eclipse of January 1st, 1889." The only two eclipses worth observing for the next two or three years are this one and one in December of the same year, which is visible at a place on the west coast of South Africa, about fifty miles south of St. Paulo de Loanda. The eclipse there is of rather long duration—about 3½ minutes—and it may be found a very favourable opportunity for observing.

ROYAL BOTANIC SOCIETY.

At a meeting of this Society, held on January 28th, Mr. G. P. Gassiott (Vice-President) in the chair, it was announced that the donations included seeds of the sweet-scented Australian gum tree, *Eucalyptus citriodora*, presented by the Hon. A. Deakin, of Melbourne. This is one of the less frequent of its kind, being found only in a few localities in New South Wales and Queensland.

Young plants of the tree, three or four years old, grown in the Society's conservatory, were exhibited at the meeting.

LONDON INSTITUTION.

THE Astronomer Royal for Ireland gave a lecture on the 2nd of January upon the wonders of the visible stars, and the facts and truths we know of them. The visible stars we all know, but there are myriads of others whose light is too faint to touch the human retina, but has power enough to stamp its strange message upon a sensitised photographic plate placed in the telescope. With the aid of many lantern slides the lecturer explained the constellation Leo, warning his audience that no telescope, however powerful, would show the mane, claws, and tail wherewith the artist usually encircled the stars that compose the group. He then took the Great Bear, and told how the unaided eye could discern three small stars within the square of the constellation, and a good opera-glass would show at least eighty more. Ursa Major being selected as a sort of central terminus in the heavens, all set off in various directions to pay visits to Castor and Pollux, to various beautiful double stars that apparently waltz round each other to the slow time of 900 years for a single revolution, and to the "Radiant" of Leonides, right on the ecliptic, from whence spring the vast showers of shooting stars that startle and delight our own little world at recurrent intervals. Many of the nebulæ are star clusters; others, such as the nebulæ in Andromeda, and the long beams of light with a central intensity, are but masses of such gases as we are cognisant of on our earth. The central scientific question of the lecture was, how is it possible to measure the distances of so-called fixed stars? and the audience was told how Bessel observed the motion of a near star by comparing it with another object, and deduced the distance by noting the relative displacement of the two bodies. The nearest star to us is not, however, visible in London; it is in a sense the property of our cousins on the other side of the globe; it is bright and beautiful; it is known as Alpha Centauri; its sidereal distance is the shortest we know of; and it amounts to twenty millions of millions of miles. The lecturer guarded himself against being accurate as to feet and inches, but he guaranteed every million. To give an idea of this distance, which is almost unthinkable, he supposed a railroad constructed from Finsbury Circus to this, the nearest of the stars. He asked what the fare would be, and placed the rate at the low figure of one penny for every hundred miles, that is to say, a rate that would take one from London to Edinburgh for fourpence or fivepence. He then took the sum total of the National Debt, at, say, seven hundred millions, and imagined a traveller going with that sum in sovereigns in 5,000 carts to the booking office, that being the number of carts requisite to carry the sum in question. Having told his audience the many thousands of years the booking clerk would take to count the sum, working day and night, he asked if we thought it would be sufficient to pay the fare, and startled them by saying that the conscientious clerk would require just 105 millions sterling before the fare was paid.

Our sun was but one of the host of stars, and if we were 200,000 times as far away from him as we are now, he would shrink up into the insignificance of a small star—a very pigmy among the giants. Indeed, from an astronomer's point of view, we attach vastly more importance to our little sun than he intrinsically deserves; for there are other suns, such as Sirius, for example, that are many times as large. The motion of a star across the plane of the heavens can be observed and noted, but the movement of one coming straight at us, "end on," as it were, no telescope can note, and here it is that the valuable method of Huggins comes in. He noticed the displacement of the hydrogen line in the spectroscope of certain stars, and proved that it arose from their motion directly towards us.

In his second lecture on the 9th January, Sir R. Ball devoted himself to the Unseen Universe. He began by referring to the vastness of the universe which was unseen by the ordinary eye, and even by the most powerful telescope which had yet been made. The photographic art was the instrument which yielded to the astronomer a knowledge of innumerable stars which the telescope itself did not reveal. The faintest stars eluded the greatest telescope, but they did not elude the photographic plate, and were impressed in millions upon it where the telescope disclosed no sign of their presence. He exhibited several photographic sections of infinitesimally small portions of the heavens, each of which showed an innumerable multitude of stars, most of them, he remarked, quite invisible under the most powerful telescope. It was by the means of photography that the heavens were being mapped with a completeness and on a scale which no telescope could have enabled astronomers to attain. But beside these stars, which were beyond the reach of all our means except the photographic plate, there were other suns which might be said to have gone out and expired, and were now speeding, black and invisible, through the depths of space. Such a fate would one day overtake our own sun. The structure of that body was intermediate between a solid and a gas. It was constantly shrinking and becoming less and losing its heat, which it was radiating into space. Yesterday the sun was larger than it was to-day, and the day before yesterday it was larger than it was yesterday. So if we carried our minds back and back through long ages of astronomical time, we would reach a time when the sun was infinitely larger than it is at present, and when it was a vast mass of glowing vapour launched in space. But our sun was only one among many stars, each of which had shrunk down also, like it, from a mass of glowing vapour, and some of which had already ceased to shine at all and had become invisible.

THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY (GLASGOW BRANCH).

AT the meeting on the 19th ult., Mr. A. Silva White, the Secretary, read a paper on the Antarctic region.

There was, he said, an area of nearly 8,000,000 of square miles within the Antarctic Circle, where the forces of nature combined to raise up a barrier which, "since the world began," had only been broken through at a few isolated spots by the adventurous navigators of modern times. Within this area—or within the parallel of 70 deg. south—they had conclusive evidence of the existence of a great mass of glaciated continental land, which, according to Mr. John Murray, must be some 3,500,000 square miles in extent, or greater than the area of Australia. Dirik Guerritz, a Dutchman, is reputed to have been the first to penetrate (January 1600) these remote southern regions; his vessel, which formed part of a squadron under Simon de Cordes, being driven by a

furious storm as far as 64 deg. of latitude, south of the Straits of Magellan. Several captains of whaling ships (Weddell in 1822-24, Biscoe in 1830-32, Balleny in 1839, and others) had since then paid flying visits. But the only real expeditions had been the following:—(1) Cook, 1772-75; (2) Bellinghausen, 1819-21; (3) D'Urville, 1837-40; (4) Wilkes, 1838-42; (5) Ross, 1839-43. Ross, in his two ships, the *Erebus* and *Terror*, spent three years chiefly in the Antarctic regions—his general object being to reach the South Magnetic Pole. He attained the highest southern latitude (78¼ degrees), penetrating to within 700 miles of the Geographical Pole, and 2,000 miles due south from Otago, New Zealand, and discovered a mass of high volcanic land, 8 degrees of latitude, which he called Victoria Land—the most southern known land in the world. Its average elevation was from 8,000 to 10,000 feet, culminating, as far as was ascertained, in an active volcano—Mount Erebus, which Ross estimated to reach 12,367 feet above the sea level. His further passage south was barred by a perpendicular ice-wall, from 200 to 250 feet high, which he followed to the east, without finding an opening, for altogether 450 miles. The American expedition, under Wilkes, sailed for 1,500 miles along the coast, and found a uniformly perpendicular wall of ice, wherever he was able to approach it. The French expedition, under D'Urville, were unable to pass the 65th parallel, and everywhere met with an impassable pack where they they had hoped to find open water. They, however, at another spot discovered and "annexed" Adélie Land, which was a matter of some consolation to them. Mr. White next proceeded to notice in some detail the leading physical and geographical conditions that were known to exist in the Far South. Speaking of the animal life of the region, as observed chiefly by Ross, he said that on the ice and in the water were innumerable seals, varying alike in size and colouring; and there were also sea lions and sea elephants. Whales had been seen by all Antarctic voyagers, though their numbers had most recently been greatly diminished by the activity of whaling vessels. Penguins abounded, and petrels, the sooty albatross, Cape pigeons, Skua gulls, and other oceanic birds were also met with in large numbers. The "bye history" of the floating ice islands and bergs—shed from the parent ice cap that surrounded the Pole—was also described. They might gather some idea of the dangers Ross must have encountered when they remembered that the Antarctic icebergs were sometimes found to be four miles in diameter—veritable ice-islands—and that they were constantly colliding and disintegrating. In conclusion, he said that as these high southern lands, unlike those in the Antipodal regions, could be approached from all sides at every season of the year, they might reasonably have supposed that they would not have been for so long unexplored had any commensurate advantage to trade or shipping been anticipated. Their considerable knowledge of the Arctic regions was due, not to any special claims for their scientific exploration, but chiefly to the fact that whilst there was a north-east and a north-west passage to explore, or a short cut across the Pole to the Indies to discover, commerce persistently endeavoured to break through the barriers of the frozen north. In the Antarctic, on the other hand, commerce had concerned itself only with the sealing and whaling produce. To the natural sciences it offered an area of almost virgin ground, and until it had been systematically explored and some knowledge of it obtained by synchronous observations, none of these sciences could be properly equipped for a thorough investigation into the cosmogony of the globe. It might be a long time yet before the nations recognised how much their progress was regulated by, and dependent on, the progress of science, but they were sure there would always be men who would impress on the public the paramount importance of investigating the Unknown Continent of the Far South.

LIVERPOOL SCIENCE STUDENTS' ASSOCIATION.

At the meeting on the 13th ult. Professor Hele Shaw delivered a lecture upon the "Theory of Rolling Contact." He commenced by stating that when two solid bodies roll upon each other, points in the surface of one successively come in contact with corresponding points in the surface of the other in a way which differs essentially from that which occurs in sliding contact. It was this fact which accounted for the use of wheels, and such was the importance of the subject, about which not much was generally understood, that he felt it was worthy of being brought before the Association, and also certain new experiments which he proposed to employ in order to illustrate several points in the lecture. He proceeded to trace by means of models the path of points in a rolling body, both on a paper screen and on smoked glass shown in the lantern. He thus made clear the reason why when hard surfaces roll in contact there is little loss by friction; various points in connection with roller bearings for dock gates, swing bridges, etc., and also ball bearings for bicycles were fully illustrated by diagrams. The use of rolling wheels for purposes of measurement and the reason of the accurate results obtained were next considered, and models of some simple measuring machines minutely described. Finally, cases of bodies in which appreciable distortion took place, such as hard wheels on a soft road or of soft wheels on a hard road, were dealt with, this portion of the lecture being fully illustrated by diagrams and mechanical lantern slides; and the various cases of great wear occurring, such as on iron rails which were destroyed in six months, whereas steel rails lasted for ten years, which could not be accounted for on the score of mere relative hardness, were explained, and other practical applications of the theory suggested.

SOUTHAMPTON LITERARY AND PHILOSOPHICAL SOCIETY.

Mr. V. W. Shore, in a paper recently read before this Society, said that in Hampshire, owing to the uniform temperature of the water of chalk springs, and to the fact that this temperature is much higher than that of ordinary river water, watercresses can only be profitably grown close to the chalk springs. The watercress harvest begins in February, as the growth of the plants is then stimulated by the abundance of fairly warm water, which the chalk then sends out in increased volume.

THE FOREST HILL SCIENTIFIC AND MICROSCOPICAL SOCIETY.

At a meeting held on the 19th ult., Mr. A. B. Harding gave a lecture on "Ice Streams and Ice Caves." Speaking of snow, he said it had considerable adhesion when it was a few degrees below, and just above freezing; but when there were several degrees of frost it lost its adhesive powers. Each snowflake was naturally trans-

parent, but in storms, on account of the number and closeness of these flakes, they often became almost opaque. The snow on the mountains, in certain countries, gradually formed into ice, thus making glaciers, which, by the pressure from above, continually travelled downwards to the snow line, sometimes at the rate of 40 feet a day. Ice caves were found chiefly in France and Switzerland; in these caves ice continually formed, and thus furnished a continual supply for the neighbouring cities. The ice at the top of a glacier was granular, but very small, getting larger as it descended. Traces of a glacier, supposed to have been 1,400 feet thick, had been found near Manchester.

SILLOTH LITERARY AND SCIENTIFIC SOCIETY.

Mr. R. McMillan recently delivered a lecture in the Cocoa House Assembly Rooms, Carlisle, on "The First Glass Makers," being a history of the Sponge family. The lecturer treated the subject in a comprehensive manner, and exhibited a beautiful and perfect specimen of Venus's cup, being pure glass woven by a sponge at a sea depth of 600 fathoms.

ARISTOTELIAN SOCIETY.

At the meeting held on January 23rd, Mr. Shadworth H. Hodgson, President, in the chair, a paper was read by Mr. Bernard Bosanquet, M.A., on "The Philosophical Importance of a True Theory of Identity." Believing that the theory of Identity is the only fundamental question at issue between thinkers interested in German speculation and those of the distinctively English school, the writer was anxious to state the question precisely, and to trace its far-reaching consequences. Attributing to English thought the view that it is the ideal of Identity to exclude Difference, he first pointed out the nature of this principle in the province of logic, referring in particular to Hamilton, Mill, Jevons, and Herbert Spencer, and explained the truer doctrine of recent logic, to the effect that an identity or universal is a meeting point of differences, and that identity in judgment is incompatible with tautology. An analogous contrast of principles shows itself in Psychology, especially in the question whether Association by Similarity can be reduced to a principle more like that of Contiguity, and in Atomism or Individualism and the opposite conceptions in Ethical and Political Science. Brilliant as has been the history of British philosophy, it reveals a certain insensibility to the organic and coherent aspect of man's spiritual achievement, as the mere inspection of the range of British philosophical literature seems to demonstrate. There may be historical causes of this defect, which does not appear to be rooted in the national character, and which participation in the present movement of European culture, including among many elements an attempt towards a more synthetic and vital philosophy, is tending to remove.

Torpedoes.—A German firm is now manufacturing a new torpedo, intended to penetrate the torpedo nets which have hitherto proved impassable. To enable the torpedo to do this, it is to have a much higher speed, and is to carry a much heavier charge. At present four sizes are being made, which can carry 40, 53, 73, and 115 kilos, and travel at the rate of 25, 26, 26·25, and 27·5 knots per hour.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

SPAWN OF FRESH-WATER FISH.

Could any reader of your excellent paper kindly answer these three questions:—

1. What is the spawn of fresh-water fish such as carp, gold-fish, tench, minnow, etc., like?
2. In what month of the year do the above fish spawn; and also, in what month do newts, efts, frogs, etc., lay their eggs?
3. How long does the spawn and eggs of the above-mentioned creatures take before it is hatched; and what is the best way to keep it to insure its hatching?

S. E. Dunkin.

COLLEGE EXAMINATIONS.

From the discussions which have appeared on the proposed new University for London, it appears more clearly than ever how the legitimate object of examinations has been altered. Instead of the examination being simply a test to show whether the student has made a good use of the facilities placed in his hands, it is now made the object for which he is to study. The examiner is master of the situation, and can dictate alike to professor and student what is to be taught and how it is to be taught. Surely this is an abuse fraught with peril to the intellectual life of your nation.

—Freiburg in Breisgau.

A CURIOSITY IN CALCULATION.

"F.R.S.E." is correct in his conclusion. December the 1st, 490 B.C., in history means, 489 years and 1 month before the Christian era. December the 1st, A.D. 1815, means 1814 and eleven months since the Christian Era: and the two sums added together = 2,304 years. J. de D.

TEMPERATURE AND RAINFALL OF 1887.

I send you the following summary of the temperature and rainfall of the past year, thinking that it may be of some interest to your readers:—

	Average Temperature.	Deviation from average of 20 years.	Rainfall in inches.	Deviation from average of 10 years.	Number of rainy days.
January	35·1°	−1·5°	2·68	−·24	17
February	38°	−1·1°	·55	−1·71	6
March	38·1°	−2·5°	1·71	−·76	14
April	43·8°	−3·4°	1·28	−·73	10
May	48·3°	−3·6°	1·79	−·48	20
June	60·7°	+2·3°	2·27	−·01	5
July	64·7°	+3·1°	·74	−1·54	6
August	60·9°	+·4°	1·86	−·68	11
September	53·9°	−1·5°	2·24	−1·43	16
October	45·1°	−3·1°	2·14	−1·19	12
November	39·8°	−·5°	1·76	−·33	18
December	36·3°	−1·6°	1·55	−1·66	16
Year	47°	−1·2°	20·57	−11·35	151

Absolute minimum temperature 9° (on grass), occurred on Jan. 17th.

Absolute maximum temperature 85·8°, occurred on July 3rd.

The most noticeable feature of the year was the long and unprecedented drought, which commenced on June 8th, and

lasted till July 4th—indeed, for a period of more than two months, till August 12th, the total rainfall amounted to but ·74 inch, or less than a third of the average of a single summer month. It will be observed that, notwithstanding the drought, the rainfall in June approximates more nearly to the average than that of any other month. This is owing to the very heavy rains which occurred on the 2nd and 3rd of this month, when 2·02 inches, or a tenth of the rainfall for the entire year, were recorded in a period of twenty-four hours.

I may add that my thermometers are Kew tested, and are placed in a Stephenson screen four feet from the ground.

B. A.

WILL MEN EVER FLY?

The question which should be placed and kept before your readers is this, Can man by the aid of mechanical appliances, attached to himself, transport himself through the air?

I state distinctly that he can, and could prove it. He would, however, have to provide himself artificially with the three essentials of flight, viz., "form," "plane-support," and "guidance." Each essential at the same time is of the utmost simplicity. But after he had done this, it would be of such little practical value, by reason of his limited powers and personal requirements in the aërial sphere, that there is no thorough student of the science of aërial navigation who would waste time over it.

Man has mastered transport on land and water, and it only remains to attain the same in air. It will be safer and quicker than marine travelling, and for mail carrying, transport to places otherwise difficult of access, and special travelling, it will be highly remunerative as a commercial enterprise.

There are several earnest and practical men engaged on the subject at the present moment, one of whom—although not adopting the bird principle—I know could construct an aërial-machine capable of driving itself through the air with great power; but he, like myself, is determined to wait until it can be properly started as a new field for the employment of practical engineers and navigators.

AVITOR.

WHAT WINDS BRING CLOUDS?

In discussing the floatation of clouds, Mr. W. J. Black, in your last issue, seems to assert that in this country clouds are rarely brought by northerly and easterly winds. I think that if he calls to mind the frequent prevalence of cloudy skies during the long prevalence of the "polar current" from which we have suffered he will reconsider this opinion. Our ancestors used on this very account to designate the North sea as the "cloudy sea."

M. L. P.

METEOROLOGICAL CHARACTER OF THE PAST YEAR.

The predominance of the polar current this year must have attracted general attention. We have had northerly and easterly winds blowing, not merely in the spring months, but in the autumn, when they are comparatively very rare.—N. E. G.

ANSWERS TO CORRESPONDENTS.

MRS. W.—We regret we cannot insert your contribution. It is very entertaining, but is not of scientific interest.

W. E. FRITH.—The best makers of magic lanterns are Perken, Son, and Rayment, Hatton Garden, E.C.; Watson and Sons, 313, High Holborn, W.C.; W. C. Hughes, Mortimer-road, Kingsland, W.; and W. C. Tyler, 48, Waterloo-road, S.E.

G. R. FARNCOMBE.—Thank you for the correction to the statement on page 80. The temperatures should have been described as below zero instead of degrees of frost.

W. TEBB.—The subject of your communication is too medical for discussion in our columns.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

HORSE-SHOE.—A horse-shoe has been patented by J. Nunn, Bolckow-street, Middlesbro'-on-Tees. The shoe is made with a rim of steel, round the edge of a very light shoe, to the inside corners of the heels, the hollow formed by the rim being filled up level by a plate of leather nailed on with the shoe. This will prevent slipping and clogging with snow or mud.

DARK LANTERN.—A police lantern has been patented by Mr. A. D. Melson, of Birmingham. The improvements consist in supplying an increased amount of air to dark lanterns without allowing of the escape of light. The reservoir, which fits into a bayonet socket, has a concave bottom, so that air entering the hole in the bottom of the lantern passes, by radial apertures, to the flame. An additional cowl prevents the top of the lantern from becoming too hot to be turned by hand.

TACHOMETER.—An apparatus for indicating the speed and direction of rotation of shafts has been patented by Mr. R. P. Fuge, Ireland. The apparatus consists substantially of a dynamo, which is connected to the shaft (the speed of which it is required to indicate) by means of a band. The two poles of the dynamo are connected electrically by insulated electric wires to the terminals of the indicating device. As the speed of the shaft alters, the electromotive force or current from the generator will alter, a voltmeter or an ammeter will show the variation in either case, and if their dials are suitably marked, they will show the alteration in the speed of the shaft.

INHALER.—Mr. F. W. Loxton, of Mile End, New Town, London, has patented an inhaler. It consists of a short tube of metal with a piece of perforated metal or other substance at each end thereof, one of these pieces being fixed, and the other movable; the movable piece is kept in its place by a mouthpiece of glass. The space contained between the two pieces of perforated metal is filled with small cubes or pieces of wood of an absorbent nature. The end of the tube that contains the fixed piece of metal is provided with a stopper of cork. The use of the small cubes or pieces of wood of an absorbent nature is to receive the drugs or other medicinal substances that may be prescribed for inhalation.

IMPROVEMENT IN HOT-WATER JUGS.—A swinging cover for hot-water jugs has been patented by Mr. E. Taylor, Edward-street Works, Birmingham. The self-acting cover is made to swing upon a wire bar fixed across the centre of a jug, the cover being so constructed that the hinges generally used in covers of a like nature are entirely dispensed with, as also the niches usually made in the sides of the jug. In order to carry out the invention, an ordinary jug is taken with a small hole pierced in each side, into which is fixed a wire bar across its centre. The cover is constructed with a raised groove across its centre, to fit the wire fixed on the jug, upon which bar the cover works, and, its centre of gravity being below the point of suspension, it always maintains a horizontal position, and may be removed by the simple process of lifting it on and off the fixed bar.

INCANDESCENT LAMP.—An electric incandescent lamp has been patented by Mr. Albany Featherstonhaugh, Charles-street, London. The invention consists in placing in an electric incandescent lamp two or more filaments side by side and close together, so that each filament is partly shielded by the other, and a certain portion of the heat generated by the electric current is prevented from escaping away by radiation. The effect of this is to increase the intensity of the light produced, for, although a certain portion of the light from each filament is lost from being interrupted by the other filament, yet the light lost in this way is simply proportional to the heat saved by the same cause, whereas the light which does go forth to the surrounding space is proportional to the third or fourth power of the whole heat.

ELECTRIC MINER'S LAMP.—An electric safety lamp for miners has been patented by Mr. S. F. Walker, of Cardiff. According to this invention a primary galvanic battery is used in connection with an incandescent lamp, the whole being made in a portable form. The battery is formed of one or more galvanic cells, according to the amount of light required. Each cell is constructed as follows:—An outer containing vessel is taken, made wholly of carbon, and inside this cell is placed a cell or diaphragm of porous earthenware; within the porous cell is suspended the positive or generating element, which may be zinc or iron, which will form, with the substance of which the outer containing vessel is composed, a galvanic cell; the zinc within the porous cell is immersed in dilute sulphuric acid; and in the space outside the porous cell, within the outer containing vessel, a suitable oxidant is placed, such as bichromate of potash.

STRINGED MUSICAL INSTRUMENT.—Mr. G. E. Mason, 45, Carr-lane, Kingston-upon-Hull, has patented a stringed musical instrument. The invention is to produce a musical instrument of that class in which the strings are played by the fingers and thumbs of each hand of the performer, and which shall obviate the disadvantage and remove the inconvenience experienced in other instruments of this class, as dulcimers and Meinhold zithers, on which only one diatonic scale can be produced; on this instrument, which is to be called the Psalterium, there is a full compass of chromatic notes, so that music in any key can be performed on it. A sound board is formed of wood, in the shape of a horizontal isosceles triangle, of which the apex is flattened and of convenient depth. This sound board is blocked to enable the same to bear the strain or pressure of the strings when tuned. On each side of this triangular frame are placed the pegs for tuning, and also at the bottom of each side are placed small pins to hold the other end of the strings. A small loop having been twisted on the strings, and each side of the box being about three inches in depth, the string will form an angle of about 45 degrees, by having one end hooked on to the small pins at the bottom and brought over the top of the opposite side to the tuning pins. On the right-hand side all the strings required to make the full complement of flats and sharps are brought together, so that the two sides taken together form a complete chromatic scale. An opening in the top sound board enables the string to pass through, so that about one-half of the string is out of sight on each side, and the strings on either side are within reach of the fingers or thumbs of both hands.

TECHNICAL EDUCATION NOTES.

COPENHAGEN.—We learn from the *Horological Journal* that efforts are being made to induce the municipal authorities of Copenhagen to start a technical school of watchmaking on the lines of the Horological Institute.

A TECHNICAL SCHOOL AND INSTITUTE FOR NORTH LONDON.—An influential meeting was held at the Islington Vestry Hall yesterday, under the presidency of Sir A. K. Rollit, LL.D., M.P., at which, on the motion of the Rev. Dr. Allon, seconded by Sir James Tyler, a resolution declaring the desirableness of founding a technical school and institute, or schools and institutes, for the North of London, on lines somewhat similar to those of the Polytechnic Institution, was adopted unanimously. Liberal donations were promised towards the object. Sir Albert Rollit, M.P., promised £100, Mr. Quintin Hogg £500, while Sir James Tyler, in a short and characteristic speech, promised £1,000 towards the site.

METROPOLITAN SCIENCE AND ART CLASSES.—The Lord Chancellor, after distributing the prizes at the Guildhall on the 31st. ult., said, he thought it was part of the duty of the State, not, indeed, to educate people absolutely, but to afford them the means of education, and to take care that those faculties that might be within them were drawn out. He did not regard what was called the intense competition with the despair, or even the depression, they sometimes heard of. After all, until the world's surface was thoroughly peopled, and until the powers of art had been exhausted—not in conquering our fellow-men, but in conquering the secrets of nature, and making her yield more abundantly than hitherto sources of enjoyment and support—we need not despair. Any one who took the trouble to see the list of wonderful inventions recorded at the Patent Office and elsewhere would see what extraordinary powers resided in the educated human intellect to master what would seem insuperable difficulties; and when he saw such a large number of young men coming forward, not for the value of the prize to be gained, but for the purpose of striving to do what they could to master abstruse and difficult sciences, his heart glowed with delight to see that there was that Anglo-Saxon spirit among us still which had made us great, and had spread our civilization in every quarter of the globe.

ANNOUNCEMENTS.

BETHNAL GREEN MUSEUM.—After the 6th February, this Museum will, on Tuesdays be closed at 4, 5, or 6, according to the season, but will be kept open on Thursdays till 10 p.m. Both these days will be free days. On Wednesdays only the admission will be 6d.

THE GEOLOGICAL SOCIETY.—The medals and funds to be given at the annual meeting of the Geological Society, on February 17th, have been awarded as follows:—Wollaston Medal to H. B. Medlicott, F.R.S.; Murchison Medal to Professor J. S. Newberry, M.D., of New York; Lyell Medal to Professor H. Alleyne Nicholson, M.D., D.Sc.; Wollaston Fund to John Horne, F.R.S.E.; Murchison Fund to E. Wilson, of the Bristol Museum; Lyell Fund to Arthur H. Foord and T. Roberts, B.A.

ELIZABETH THOMPSON SCIENCE FUND.—A circular recently issued announces that appropriations under this fund will be made at the end of 1888, and the trustees invite applications from those desiring aid in scientific work. The grants are not limited to investigations in any one particular branch of science, but to researches which, as the circular states, "cannot otherwise be provided for;" and which tend to the "advancement and prosecution of scientific research in its broadest sense." Out of the income now available, the trustees are at present disinclined to make any grant exceeding 500 dols. We observe the names of several of our own

investigators in the list of those who have received aid from this endowment.

ROLLESTON MEMORIAL PRIZE.—This prize, which is of the value of £60, will be awarded in Hilary Term, 1888. The prize is open to such members of the Universities of Oxford or Cambridge as shall not have exceeded ten years from the date of their matriculation on March 31st, 1888, and is to be awarded for original research in any subject comprised under the following heads:—Animal and vegetable morphology, physiology and pathology, and anthropology, to be selected by the candidates themselves. Candidates wishing to compete are requested to forward their memoirs to the Registrar of the University of Oxford before March 31st, 1888. The memoirs should be inscribed "Rolleston Memorial Essay," and should each bear the name and address of the author. They may be printed or in manuscript, memoirs already published being admitted to the competition.

DIARY FOR NEXT WEEK.

Monday, *Feb.* 13.—London Institution, at 5 p.m.—*The Roman Conquest of Judæa*; Rev. William Benham, B.D.
Birkenhead Literary and Scientific Society.—*Life in a Turkish Province*; Mr. J. A. Doughan.
Bradford Naturalists' Society.—*Pinus sylvestris*; Mr. J. Clayton.
Society of Arts.—Cantor Lecture, at 8 p.m., *Yeast, its Morphology and Culture*; Mr. Gordon Salamon, F.I.C.

Tuesday, *Feb.* 14.—Royal Institution, at 3 p.m.—*Before and After Darwin*; Professor G. J. Romanes.
Society of Arts—Applied Art Section, at 8 p.m.—*Principles of Design as Applied to Book-binding*; Mr. H. B. Wheatley.
Birmingham Architectural Association.—*Pompeian Art*; Mr. Whitworth Wallis.
Royal Colonial Institute, at 8 p.m.—*Recent Impressions in India and Australia*; The Right Hon. Lord Brassey, K.C.B.
Royal Victoria Hall.—*Earthquakes and Volcanoes*; Mr. E. Wethered.

Wednesday, *Feb.* 15.—Society of Arts, at 8 p.m.—*Type-Writers and Type-Writing*; Mr. John Harrison.
Civil and Mechanical Engineers' Society, at 7 p.m.—*On Sea-Water for Street-Watering*; Mr. S. Harding Terry.
Dundee Naturalists' Society, at 8 p.m.—*Geology of Dundee: the Glacial Period*; Mr. James Durham.
Cardiff Amateur Photographic Society, at 8 p.m.—*Norwegian Scenery*; Mr. C. H. James.

Thursday, *Feb.* 16.—Royal Society, at 4.30 p.m.
Royal Institution, at 3 p.m.—*Early Secular Choral Music*; Professor C. H. H. Parry.
Chemical Society, at 8 p.m.
London Institution, at 6 p.m.—*The Pictures of the Year*; Mr. Henry Blackburn.

Friday, *Feb.* 17.—Royal Institution, at 9 p.m.—*Developments of English Pottery*; Sir Henry Doulton.
Royal United Service Institution, at 3 p.m.—*The Advantages of a Simple Drill-Nomenclature Consistent for all Arms, Apropos to an Incident of the Battle of Tel-el-Kebir*; Colonel J. F. Maurice, R.A.
Geological Society. Annual General Meeting, at 1 p.m.

Saturday, *Feb.* 18.—Royal Institution, at 3 p.m.—*Experimental Optics*; Lord Rayleigh.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased; Ambers fitted.—W. GEORGE, 324, Essex-road, Islington, London.

Trouser Lengths, 5s. Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—HEWITT, 27, Winfield, Leeds.

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Castings, Parts, Materials, and Finished Models.—Catalogue, 2d.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

Mesmerism.—"This book is a very good one. Any one can learn the art from it."—*Weekly Budget*. 2s. 6d.—W. THOMAS, 22, Clarendon-road, Anfield, Liverpool.

"Playground of Science," just ready, containing novel, simple, and interesting scientific experiments, illustrated. One Shilling, post free.—TRUSLOVE AND SHIRLEY, 7, St. Paul's-churchyard, London.

Crayon Sketch from any photograph (returned uninjured), correct likeness, 15 by 11, 1s. each. Postage of one or more, 2d.—MR. COULTHARD, Bathwick, Bath.

Mechanics' Specialities.—20 large sheets fretwork patterns, 7d.; 200 turning patterns, 1s.; 300 stencils, 1s.—BELOW.

Fifty Conjuring Tricks, 1s.; 100 experiments, 1s.; photographs 100 eminent women, 1s.—COLLINS, Summerlays-place, Bath.

How to Read Character from Handwriting, 6d. How to make a lathe for few pence, 6d.—ABOVE.

Magnificent Violin; grand ringing tone. Also bow and case. Sacrificing. 17s. 6d., free. Wonderful bargain, but no use to advertiser.—B. GRAHAM, 18, Orchard-street, Ipswich.

Baker's Students' Microscope. — One eye-piece, 1-3 objective; in case, £3 3s.—MUNRO, Lyme, Dorset.

Fretwork Carving.—Catalogue of all requisites and 500 miniature designs free, 6 stamps.—HARGER BROS., Settle.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

BOOKS RECEIVED.

Proceedings of the Philosophical Society of Glasgow. Glasgow: John Smith and Sons. Price 10s. 6d.

Thorough Cultivation. Sir A. Cotton. Price 1s.

The Analyst. February number. Edited by Dr. Muter. London: Baillière, Tindall, and Cox. Price 6d.

Journal of the Society of Telegraph Engineers and Electricians. Edited by H. Webb. London and New York: E. and F. N. Spon. Price 2s.

Journal of the Society of Chemical Industry. Edited by Watson Smith. January number. London: Eyre and Spottiswoode.

Transactions of the Edinburgh Photographic Society. February number.

Transactions of the Nottingham Naturalists' Society, 1887.

Sixth Annual Report of the United States Geological Survey to the Secretary of the Interior. J. W. Powell. Washington: Government Printing Office.

NOTICES.

The Title Page and Index to Vol. I., *First Series*, now ready, price 6d.

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Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

TECHNICAL EDUCATION.—In pointing to the necessity for technical education, Professor Huxley calls attention to the fact that the present conditions of industrial life in this country are very different to those which obtained only a few years ago. Formerly the owner of a workshop had but few workmen, and his four or five apprentices were generally able to pick up odds and ends of technical knowledge, besides being the privileged recipients of the master's traditional trade secrets. Works of this small magnitude have now made way for factories where instead of five there are fifty, five hundred, and even five thousand workmen, and it is no longer possible for the master to give instruction as in former days. Artisans must therefore look outside their workshop for the teaching necessary to enable them to master the principles of their craft, and for this the technical school is needed—not of course instead of the workshop, but as an adjunct to it.

Technical education is also necessary because competition is very keen, and because the successful development of modern inventions demands an increasing knowledge of the principles on which they depend. As a general statement this almost goes without saying, but at the same time from a practical point of view, we quite agree with Professor Huxley that the wants of a particular district can best be determined by those who are actually engaged in the industries of that district. Each district should be free to act as may be best in its own interest, as each school is of local rather than national importance. Bearing on this point, it will be remembered that among the useful resolutions presented by the Bradford Technical College to the Vice-President of the Council on Education was one to the effect that technical schools should be established in the centres of the different manufacturing industries, with special reference to the industry or industries of the locality.

SANITARY WORK IN LONDON.—A correspondent of the *Times* gives an interesting summary of the work done during the past year by the Mansion House Council on the Dwellings of the People. From this it appears that the Council has succeeded in doing much in the way of remedying insanitary conditions in almost every district in the Metropolis, by means of its voluntary workers and only two paid inspectors. Over 3,500 cases have been dealt with from the central office alone, quite apart from the work done by the local committees. Sanitary knowledge has been propagated by means of free public lectures, and by the distribution of literature on the subject. There is no disguising the fact that the *vis inertia* of Bumbledom is great indeed. Local authorities are either ignorant or indifferent, if not prejudiced and actively obstructive. The Council have therefore adopted the policy of teaching and persuading the ratepayers to take a greater interest in the matter, and by so doing they hope in time to secure the election of fitter men for the vestries and district boards. In the meantime it is satisfactory to know that in many cases the mere dread of public exposure is sufficient to insure attention to the inspector's complaints. It is uphill work, no doubt, but if the result is slow it is sure, and the Council and its

workers are deserving of all praise for their disinterested and untiring efforts.

James Watt Anniversary Dinner. — At this annual commemoration, held under the auspices of the Glasgow Philosophical Society, and the Scottish Institution of Engineers and Shipbuilders, Mr. John Turnbull proposed "The Memory of James Watt," in an interesting speech, in which the achievements of the great engineer were placed in the clearest light, and some facts were brought forward which have escaped general notice. At an early date, he had conceived the idea of the screw-propeller, which he described as a "spiral oar." In 1778, he invented the letter copying-press now in common use. In 1783, he was urging the adoption of a decimal system of weights and measures, and in the same year he is described as sending to the Royal Society his theory of the composition of water, "which hypothesis Cavendish afterwards verified by his able experiments." As late as 1811, when in his seventy-sixth year, he perfected a machine for copying statuary, which he used himself with no small success. As far as the principal parts of the steam-engine are concerned, Watt left but little to be done by his successors.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

The geological record gives very decided precedence to marine animals. When a student in Prof. Jamieson's class at the Edinburgh University I was taught that land animals made their earliest appearance in the "carboniferous system," then classed in the "secondary strata." This excluded the existence of land animals from all that vast period during which the great masses of Laurentian, Silurian, and Devonian rocks were deposited. More recent discoveries prove the existence of land animals earlier than the Devonian, even so far back as the lower Silurian. The discovery of a fossil scorpion there proves more than its own existence, if, like modern scorpions and other spiders, its habits were carnivorous. Such remains of land animals in and below the Devonian rocks are, however, so very rare and exceptional that the geological census represents our earth as a world of waters teeming with animal life, while its dry land was a sterile and nearly lifeless desert.

These facts are suggestive of many reflections and some queries, the first being whether the geological record really does afford a fair general view of the history of life on the earth. My own opinion is that it does so, as regards shelly and bony marine life, and approximately as regards the shelly and bony fresh-water life, but not so as regards any class of the inhabitants of dry land. Most geologists admit this, but the general impression conveyed by their works to general readers is different.

We must not forget that the geologist only obtains fossil specimens of animals that have been drowned, or buried, or have died in caves. Taking the life-history and death-history of the animals that now exist on the earth, and excluding the agency of man, how many are there of those daily dying around us whose remains are thus preserved?

The stratified rocks in which fossils are found have been, with a very few rare exceptions, deposited under water, and whatever they contain must therefore have got into the water in order to be there. The manner in which the deposited material of these rocks has reached the water must not be forgotten. It came there by disintegrating violence of some kind, by "denudation," a wearing away by weathering, flood-washing, wave-breaking, or glacier-grinding. All such agencies capable of tearing up and carrying down to the sea the solid material of the land must have been very destructive to any remains of life that may have laid upon it, or even have been buried beneath it.

We should also understand that the further we go back in the geological record, the more destructive to possible organic remains must have been the denuding and down-drifting agencies. Thus the denudation of the dry land of the Laurentian period supplied material for the deposition of rocks of the Silurian; that of the Silurian, in like manner, afforded by its demolition, material for the Devonian; and so on. Each of these great divisions include a large number of subdivisions, in each of which these denudations and re-depositions have been repeated. Thus a given block of new red sandstone may contain grains of sand that have been subjected to twenty-fold grindings, and all its associated organic material correspondingly pulverised and obliterated. A multitude of monsters might have lived on the dry land when the Oldhamia flourished in the Silurian seas, and yet not a bone or tooth of any one of them be ever known to man.

There is another possibility that has been argued as impossible, not by geologists or any others of scientific authority, but by theological disputants. The possibility of a general deluge has been denied on the assumption that there is not sufficient water on the globe to cover the land. This of course is true, if the levels continue unaltered, but a little examination shows that only a moderate disturbance would be sufficient to submerge all the plains and fertile valleys, and leave nothing more above the ocean than insular peaks or barren rock.

In last January's number of the *Scottish Geographical Magazine*, Mr. John Murray publishes the results of long investigation of this subject. He estimates the bulk of the dry land above the sea is 23,450,000 cubic miles, while that of the waters of the ocean is 323,800,000 cubic miles, or between thirteen and fourteen times as much as that of the dry land. There is enough water in the sea to cover the whole of the globe with a depth of two miles if the land were levelled.

Seeing how greatly the levels of land and sea have varied (I have picked up marine fossils on Mount Pilatus at 7,000 feet above sea level), it is not only possible, but very probable, that during some geological periods there was very little dry land at all on our globe, and the further we go back the greater is the probability that such dry land was but barren rock, seeing that our fertile soils are the products of repeated disintegrations and re-depositions of rock matter.

America is a very tall country. They have big things of all kinds over there. Among them is a very big glacier in Alaska. The ice is 5,000 feet wide and 700 feet thick where it enters the Muir Inlet (59° N. lat., 136° 40′ W. long.), and according to Mr. G. F. Wright it advances

during the month of August at the rate of 40 feet per day. If this is correct it beats the record of European glacier pace by enormous odds, and it pours down 140 million cubic feet of ice daily. It keeps up a supply of icebergs which are continually breaking away from it, some having a cubic capacity of 40 millions of cubic feet. But these dimensions are only those of a shrunken monster. According to Mr. Wright it has been fading away rapidly for a long time. He tells us that it has receded several miles up the inlet during the present century, and fallen 1,000 or 1,500 feet.

The article on "The Use of Forests" on page 89 of this magazine opens a very interesting and important subject. The deserts of Asia Minor and Africa owe their barrenness more to the destruction of forests by the improvidence of man, and by his wilful devastation as conqueror in barbaric warfare, than to any natural necessity.

AIR FILTER.

IN all systems of ventilation the fresh air is drawn from the outside of the building to be ventilated, but in large towns, or in manufacturing districts in the country, the air is more or less charged with soot and dirt. It is therefore, very desirable to filter the air before it reaches the interior of the building, and when mechanical means of ventilation are adopted it is comparatively easy to make the air pass through suitable filtering media. There are many appliances for effecting this, and among them is the one invented by Dr. Möller, of Germany, and made by Messrs. Körting Bros. In this apparatus the air is filtered through folds of cotton cloth of suitable thickness, with a rough surface. The air follows the directions indicated by the arrows in the accompanying figs. 1 and 2, and in order that it may be filtered with as little resistance as possible, there are several chambers or filters, E, E, each provided with cloth. There is thus a large filtering area, and we understand that as the air passes only once through the cloth the usual difference of pressure between the incoming non-filtered air and the outgoing filtered air is equal to a column of water only two-tenths of a millimetre high. When necessary the resistance can be reduced to one-tenth of a millimetre, by increasing the filtering surface. As the velocity of the air current is usually small, the particles of dust do not penetrate the cloth, but remain on the surface or fall backwards into the iron chamber or pocket. The cloth should be occasionally taken out and cleaned, and the filter should be fixed so as to be easy of access.

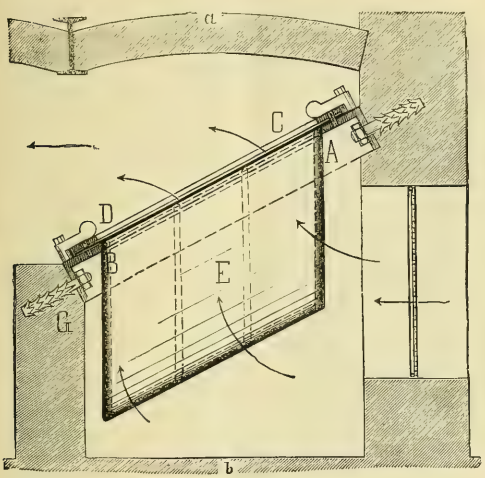


FIG. 1.

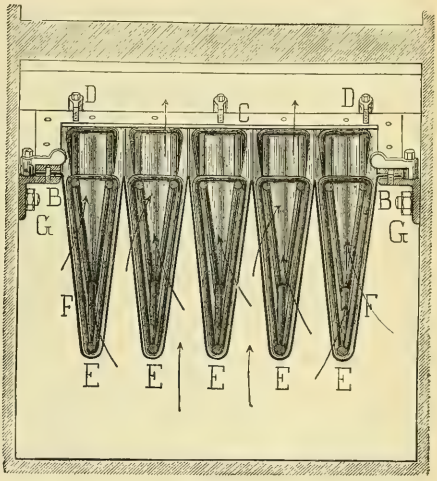


FIG. 2.

Among the uses of forests is one that I rarely see mentioned, although it is of considerable importance. I refer to their action as flood moderators. Townspeople are not familiar with forests in winter time.

There are no picnics then, and consequently the fact that a wood which is a pleasant resting-place in summer commonly becomes a wretched swamp in winter, is imperfectly understood. When struggling through such places in January, I have wondered how Robin Hood and his merry men maintained their mirth all "under the greenwood tree."

This holding of so much water by the decaying leaves and undergrowth is, nevertheless, a great blessing, especially in hilly countries, where otherwise—as in Spain, for example—the rivers are furious torrents in winter and dry in summer. Every wood becomes a reservoir, from which the accumulated waters of the wet season gradually and steadily percolate, supplying the rivers and lower grounds just when water is a blessing, and checking the floods when it may become a curse.

NEW SOURCE OF MANNITE.—J. Kachler (*Dingler's Journal*) has obtained mannite by allowing the cambial juice of the pine to stand for some time and ferment slightly.

ARSENIC-EATING.

MORE than thirty years have passed away since Professor Johnstone, in his well-known "*Chemistry of Common Life*," first called public attention to the internal use of arsenic in various parts of the world, especially in the Austrian province of Styria. His statement was received with no small surprise and, as it often happens in case of anything novel, even with derision. To sift the matter to the bottom was a matter of some difficulty, as the consumers of this formidable drug keep their practice a secret. At last, however, after not a few denials and re-assertions, the truth of Professor Johnstone's disclosures was established.

An Austrian physician has recently had the opportunity of examining the physical and mental condition of several arsenic-eaters, who had been taking variable quantities of ordinary white arsenic or red orpiment at intervals for a long period, in one instance even during thirty years. The presence of arsenic in the urine showed the average dose of the drug taken daily to be nearly half a grain, or three times the amount of the largest dose prescribed in medicine. Physically the persons examined were quite up to the average, and able to perform ordinary manual labour, while their intellectual level was not below that of their class. Some of the arsenic-eaters were thin, others normally stout, and the arsenic habit did not appear to prevent the formation of fat. In several cases the cause of the habit was alleged to be the strengthening influence of arsenic on the digestive organs. None of the eight cases under examination showed symptoms of slow, chronic poisoning. The drug is principally taken in order to facilitate respiration when climbing steep mountains, and it is said to answer this purpose exceedingly well. Habitual arsenic-eaters allege that the drug acts as a preservative against disease and raises the spirits during fatiguing journeys.

Another motive for its use, especially among girls, is that it improves the complexion, rendering the skin remarkably smooth and clear. Grooms occasionally administer arsenic to horses with the alleged effect of giving a beautiful gloss to their coats.

It must not be supposed that in an age so given to quackery, and so enamoured of unsafe cosmetics, this practice would remain confined to Styria—if such ever was the case. Accordingly Dr. Büchner, a Munich physician, who has recommended arsenic in tuberculosis, gives the authority of his name for the statement that arsenic is habitually mixed with the dishes served upon the tables of young ladies' boarding-schools in Switzerland, and mentions that young persons are far better able to assimilate the drug than middle-aged or old people.

We do not know in how far parents—at least English parents—would approve of the fascinations of their daughters being heightened in such a questionable manner. It must obviously be unsafe for the cook at a boarding-school to be entrusted with the responsibility of so dangerous a poison. Even if the quantity for the whole school is accurately weighed out, who is to guarantee accurate mixing, so that each damsel may get her allotted fraction and no more?

Accordingly we regarded Dr. Büchner's statement, though given by a contemporary of good repute, with some little doubt, and should probably have dismissed the matter from our mind, save for a very unexpected confirmation.

Looking over the transactions of the Pharmaceutical Conference of the State of New York, we saw a number of queries proposed for investigation, against the next yearly meeting in 1888. Amongst these was a question as to arsenical complexion-wafers, how much arsenic did they usually contain, and what ill effects, if any, were traceable to their use? This seems to settle the matter. The use of such arsenical wafers for improving the complexion is, therefore, in America at least, something well known to chemists and druggists, and the only questions are what is the dose of the poison, and what may be its effects? We cannot help expressing a hope that this practice may not gain ground in Britain. It is rumoured that persons who have once habituated themselves to arsenic-eating cannot lay it aside, and that if they are ever prevented from obtaining their daily dose they experience the horrors of slow arsenical poisoning.

Another point on which more light is wanted is the possible effect of arsenic-eating, not upon the individual, but upon his or her posterity. We have in these days so many factors contributing to racial degeneracy that their possible increase is earnestly to be deprecated.

ANOTHER REMARKABLE METEORITE.

IN the first number of our new series we gave a description of the famous St. Croix meteorite, but Mr. George F. Kunz, the distinguished mineralogist, has since got into his possession a much larger specimen. This meteorite was found in Taney County, Missouri, twenty-eight years ago, but was not considered at the time to be of meteoric origin. Mr. Kunz, however, was informed about it, and, knowing its value, at once secured it. The mass measures 13 by 13 inches across the face and 12 inches through, and weighs 197 lbs. The St. Croix meteorite's dimensions are 8 by 8 inches across the face and 7 inches through, and weighs 53 lbs. In the Taney meteorite are two large crystals of olivine, one measuring 4 by 3 inches, and another $2\frac{1}{2}$ inches by $1\frac{1}{2}$ inches; this part being so much lighter in colour than the rest of the mass, and so much more easily detached that the larger crystal has been almost entirely picked out to a depth of 2 inches. At one corner of the mass there is an enclosure of augite, which is grey in colour, and granular in structure, and has all the appearance of a common grey pebble (3 inches by $1\frac{1}{2}$ inches) inserted in the iron. The surface of the meteorite is deeply pitted, and in many spots traces of a black crust are still to be seen. Mr. Kunz has made microscopic sections, and in these he found that the olivine did not occur in separate crystals, but rather in aggregations of irregularly-shaped grains, surrounded by brown iron veins, and with banded anthlite grains interspersed. These aggregations he found to be full of black microlites, glass masses, and needle-shaped clear crystals, imbedded in the metallic iron without any border of alteration. The boundary line is perfectly sharp, fresh, and distinct, the olivine appears to be fresh, but is clouded with the brown iron stains abundantly scattered through it. The specific gravity of the mass is 4·484, and it consists of iron and nickel. According to Professor Swallow, the mass belongs to the rather rare group of amygdaloidal meteoric irons, in which the peridotic ingredient preponderates over the nickelic iron. The iron is remarkable for its whiteness, while the peridot is of a well marked green colour and distinctly crystalline. A considerable number of meteorites fell on the 4th of July, 1859, and this was among them. The discovery has caused some sensation among mineralogists.

PHOTOGRAPHY BY FLASH-LIGHT.

TAKING a photograph by means of a flash-light generated by the deflagration of various explosive compounds is no new idea, but owing to a recent discovery by Dr. Henry G. Piffard, of New York, the process has become not only exceedingly simple, but also perfectly safe, a recommendation that could hardly be given to the previous explosive mixtures used for the purpose, containing as they usually did potassium chlorate in considerable quantities, a material that is liable to ignition from percussion or friction.

One of the earliest compounds of this type was introduced by Gädicke and Meithe, and consisted of magnesium powder, potassium chlorate, and sulphide of antimony, and no doubt very good results were obtained by its use. The use of magnesium powder mixed with fine sand, to separate the particles, allowed to fall in the form of a stream into the flame of a spirit lamp; and also the well-known magnesium ribbon hardly come within the category of flash-lights, as the duration of the exposure of the sensitive plate necessary to produce a good negative is measured by seconds, but may be mentioned as leading up to Dr. Piffard's neat little discovery.

This device is simplicity itself: a small lock of gun-cotton is taken, and the fibres loosened and pulled apart until it forms a light disc of about two inches diameter, and then the finest magnesium powder is lightly sprinkled over it, and the powdered wad is ready to be flashed off at any moment by the application of a lighted taper. The size of the wad necessary is of course regulated by the subject to be photographed; for portraits the wad may be three or four inches in diameter, which will give a full exposure to ordinary rapid gelatine plates, but the writer found in his experiments that to get a sharp photograph of an animal, such as the common or garden cat, illustrated below, an exceedingly small gun-cotton disc was necessary, owing to the rapidity with which *Felis domesticus* shrinks from the vivid flash. The illustration depicts a very placid-looking animal, but the lightning-like velocity with which the victim vacates its position when the flash takes place has to be seen to be thoroughly believed. However, no matter what the agility of the "subject," the flash comes in an easy winner if kept, as above stated, of small dimensions.

The cost of producing this light is trifling; for instance, the above photograph was taken with gun-cotton and magnesium powder, weighing together under two grains! retail price about half-a-crown an ounce; it was, however, ignited within two feet of the "subject," the lens used was a very rapid "Suter" lens with full aperture, and the gelatine plate was one of Messrs. Elliot and Fry's ordinary commercial plates for rapid photography.

PHOTOGRAPH OF MANX CAT TAKEN BY FLASH LIGHT.

For portraits from 15 to 20 grains of cotton and powder combined, or even more, may be used with advantage, as the light has to be kept further from the "subject," and has also to be toned down and carefully reflected to eliminate hard shadows and obtain artistic results. A human being is not nearly as quick as a cat in getting his facial muscles in motion, but the writer finds that, after having once half blinded his human subject with the magnesium flash, it is almost impossible to prevent him screwing up his eyes *before* the next flash; now a cat never seems to learn that a lighted taper is the precursor of a blinding flash, so it reserves its grimaces until it is too late to have them recorded on the faithful gelatine; and we are led to the not unreasonable deduction that there is a difference of reasoning power in the two "subjects," not that we wish to cast any slur on our feline sitter, for he is a Manx tom of exceptional intelligence.

It seems likely that the magnesium flash-light may be useful to naturalists and others, for recording the motions of nocturnal insects, etc., when under examination; for instance, Darwin would no doubt have been delighted to have secured a picture of his interesting earthworms at work above the surface of the ground, moving his fragments of coloured paper, etc., which would be quite possible by this means, but impossible by any other, owing to the retiring habits of these slimy little agriculturists; indeed, if the invention develops as it promises at present, the uses to which it may be put in the arts and sciences are innumerable.

CONTRACTED HANDWRITING.

THE writing of the future will probably be done mechanically by the Morse code, or something like it. Printers, schoolboys, and in time everybody, will learn the dots and dashes, which are as yet familiar only to telegraph clerks and the inmates of certain schools for the blind. But this is looking a good way ahead. Shorthand is more immediately available. Useful, and even indispensable, as it is to many people, shorthand can never meet the case of all who wish to write fast. It is subject to two striking disadvantages—(1) that several hours a week must be spent in practice to maintain speed in writing and reading, and (2) that the first copy needs transcription for the press or for ordinary readers. Accordingly, many people in our generation, who are not writers by profession, have felt the want of some time-saving method of long-hand. Macaulay, Darwin, and other authors gained the rapidity so essential to free writing by hasty abbreviations in their rough drafts, putting *cle* for *castle*, and so on. This is no doubt a good plan for important work, which needs thinking over again, but, like shorthand, it implies transcription. Newspaper men have established a system of useful contractions, which are free from ambiguity, and understood by all compositors. Omitting such conventions as *H o C*, which are less important to non-political writers, we give a selection of symbols generally serviceable. All may safely be used in writing for the press.

The	l	Might	mt
Of	o	Should	shd
That	t	Shall	sh
With	w	Have	h
Without	wt	-ing	-g
For	f	-ation	-n
From	fm	-tion	
Your	yr	-ion	
Which	wh	-bility	-by
Great	gt	-ment	-mt
Would	wd	-tance	-tce
Could	cd		

By actual trial we find that the adoption of these contractions saves between one-ninth and one-tenth of the space. A little contrivance will bring to light many abbreviations useful in special cases. For instance, the student, reporting chemical lectures in his note-book, may write *Cate* (*C-ate*), *Sate*, *Pate*, for *Carbonate*, *Sulphate*, *Phosphate*, and so on with other technical words, where the chemical formula is unknown, or too complicated for instant use. More important than the saving of time and space is the relief to the attention, which is spared a certain number of tiresome and mechanical details.

WHISTLING LANGUAGE.

AN observation made by Lieutenant Quedenfeldt, a German officer, during a residence in the island of Gomera, is something more than a mere anthropological curiosity. This island is one of the Canary group. Its aspect is peculiarly rugged. Its surface is intersected by a number of gullies and ravines, which branch out in an intricate manner from the central table-land. As there are no good roads and bridges these ravines can only be crossed at particular spots, and there only with difficulty. Hence, two persons living within a stone's-throw of each other as the crow flies, might have to travel miles to get within speaking distance of each other. They communicate, therefore, by whistling, which is audible to a greater distance than speech. These whistles are not mere signals, but, as a contemporary puts it, are speech translated into whistling. According to Lieutenant Quedenfeldt, a Gomero can in this manner carry on a long and complicated conversation with an interlocutor a mile off.

Here, therefore, we have rational communication conducted, and ideas—not mere signals—conveyed without the use of articulate speech. We are thus enabled to understand that the lower animals may be able to communicate with each other without anything like human speech, without anything traceable to "roots," and having a grammatical structure. We believe that this fact, if carefully weighed, will be found to annihilate the objections to evolution—so far as man is concerned—which have been formulated by certain philologians.

In this connection we are reminded of the conversations carried on by traders in Arabia, Persia, and Africa with their fingers. This is nothing like a dumb-and-deaf alphabet. The hands of the two parties are covered with a cloth, and by mutual touches, pulls, and pressings they are able to discuss a bargain, and come to an understanding without any possible interference from by-standers. Wherein does such a finger-language differ essentially from the antennal language of bees and ants?

RECLAMATION OF WASTE LANDS.

TWO of the most successful improvements on record have been effected in France within the last few years, both due to M. Chambrelent. One of the localities thus transformed is the plain of Camargue, extending from Arles to Marseille. It was, until recently, a tract of salt marshes, unproductive and unhealthy, and exposed to inundations. It has been protected by dykes against the Rhone and the sea, and its waters are drained into a lake, the Valcares, whence they are run off by opportunity into the sea. Two large pumping stations irrigate the land with soft water from the Rhone, thus washing away the salt which rendered it barren. More than 10,000 acres of this land are now laid out in vineyards, which are already doing well. A still more important reclamation, is that of the Grandes Landes on the way from Bordeaux to Pau. This territory, nearly two million acres in extent, was till lately barren and fearfully unhealthy, but is now both productive and salubrious. It has exported during the last two years 130,000 telegraph poles and nearly 2,000,000 railway sleepers.

General Notes.

The Recent Eclipse of the Moon.—On this occasion the Observatory of the Trocadero, at Paris, was thrown open to the public. At 8 p.m. M. Leon Jaubert delivered a preliminary lecture on the various phases of the approaching eclipse.

Large Gas-Engine.—At Deutz, near Cologne, an Otto gas-engine is being made of 100 horse-power effective. It has four cylinders, and will be driven by Dowson gas. It will be interesting to learn whether a gas-engine of such a size can successfully compete with modern steam-engines.

King's College Extension Lectures.—Professor H. G. Seeley began last Thursday, at the Shoreditch Town Hall, a course of three lectures on "The Earth's Surface," similar to the People's Lectures carried on in the autumn by the London Society for the Extension of University Teaching.

Fraudulent Colouring of Coffee.—According to K. Sykora (*Listy Chem*), inferior and damaged coffee beans are coloured with mixtures of indigo, bone-black, chromate of lead, and China clay. Gamboge and ultramarine have also been detected. Of these ingredients chromate of lead (chrome-yellow), and gamboge, are decidedly poisonous.

Preservation of Eye-sight.—From a medical contemporary we learn that the Austrian Minister of Education has forbidden the use in school of all books, German or foreign, published in certain collections on account of their small and trying print. Short-sightedness in Germany and Austria has been found to be connected with the use of the crabbed German type.

New Minor Planet.—A new minor planet (No. 272) was discovered by M. Charlois, of the observatory at Nice, at oh. 2m. a.m. on the 5th inst. The position at the time of discovery was:—Right ascension, 10h. 1m. 11s.; north polar distance, 70° 39′ 38″; the daily movement in right ascension is *minus* 52s., in north polar distance *minus* 5′. The planet is of the 13th magnitude.

Landslip at Neuchatel.—Swiss and South German papers report a serious landslip, which has done great mischief to the railway from Yverdun to Fribourg, which passes over the shore of the lake of Neuchatel. Over 100 mètres of the line were covered with huge blocks of rock and thousands of tons of rubbish. The landslip has been attributed to a sudden thaw and to the sinking of the lake, the level of which is much lower than usual at this time of year.

Queen's College Literary and Scientific Society, Belfast.—At a meeting of this Society the question of "An Ulster University" was discussed. The dominant idea, both of the friends and the opponents of the new scheme, was that it would destroy the Royal University. No novel light was thrown upon higher education, and the speeches towards the last seemed to trench upon party politics. It was finally decided, by a majority of 125 votes to 26, that an Ulster University was not to be desired.

Electric Lighting in the City.—At a meeting of the City Commissioners of Sewers, the Streets Committee submitted for adoption a proposed arrangement with the Anglo-American Brush Electric Light Corporation for lighting a portion of the City by electricity. It was proposed to light the district commencing from the front of the Royal Exchange, and lying between the Poultry, Cheapside, St. Paul's-churchyard, Ludgate-hill, and Fleet-street on the north, and Queen Victoria-street and the Embankment on the south.

Properties of Fluorine.—Drs. Wallach and Hensler have been experimenting on aromatic substitution of fluorine, and have drawn conclusions on the nature of fluorine which they publish in *Liebig's Annalen*. The specific gravity of a compound is decidedly raised by the substitution of fluorine for hydrogen, though the boiling point was scarcely affected. The interval between the boiling points of corresponding iodine and bromine products and that between those of bromine and chlorine is smaller than that between the chlorine and fluorine derivatives. Hence the boiling point of free fluorine is probably much lower than that of free chlorine.

Telephonic Communication for 500 Miles.—The telephone is expected to work between Paris and Marseilles on the 1st of July. The wire will be of bronze, and will be underground as far as Nogent-sur-Marne, where it will join the railway telegraph line. The distance is 500 miles, rather more than double that from Paris to Brussels, but the experiment of connecting the two wires between these places—the voice thus going from Paris to Brussels, back to Paris, and then again to Brussels—is considered a proof that communication will be easy.

Possible Water Famine.—Sir J. B. Lawes writes to the *Times* to point out the possibility of a serious water scarcity in the approaching summer and autumn. He states that, as a general rule, not much of the rain which falls between March and September passes through the soil to feed the springs and the rivers. He admits that we have, indeed, February before us, but he reminds us that, contrary to the old saying, February is generally the least rainy month save one in the twelve. So that, unless the summer proves exceptionally rainy, like that of 1879, a scarcity of water will probably be experienced, and every possible economy ought to be adopted in water consumption.

Steam and the Steam Engine.—A lecture on this subject was given on Tuesday evening by Professor Stuart, M.P., in the lecture hall of the Shoreditch Young Men's Christian Association. The lecturer, who illustrated his remarks by means of sketches on a blackboard, explained the scientific theory of the steam engine, with the great discovery that heat can be turned into work, and *vice versa*. Referring to various forms of the engine, he said that the most modern only utilised a thirteenth part of the heat given by the coal. The lost heat was sometimes used for other purposes than that of working the engine, but not always; and he had often thought that in towns it might be applied to some general purpose, such as warming dwellings or supplying baths.

Newly-built Houses.—According to the *Medical Press and Circular*, at the town of Bâhe, in Switzerland, a

decree has been put in force prohibiting the occupation of houses within four months of their completion. As recently as the earlier part of the present century, in the North of England, custom though not law, required the lapse of twelve months after completion before a house could be tenanted. It has been estimated that a modern brick-dwelling of medium size requires about 10,000 gallons of water in its construction, much of which is still present when the workmen withdraw. Heat is of less use in getting rid of this moisture than free ventilation. We must not fail to add that to light gas in rooms with a view of drying them is a capital mistake, since all the hydrogen in the gas is converted into its equivalent of water, every part of hydrogen thus consumed yielding eight parts of water in the state of vapour.

A Monster Magnet.—One of our leading army engineers has brought before the engineers' class of late an experiment of startling nature. Wonderful results are promised. It is a monster magnet made of two Rodman guns, which are connected at the breech. Around them is wound about twenty miles of submarine cable. The cable is some that has been used in the torpedo service. It is wound and fastened in a substantial manner, making a powerful electro-magnet when electricity is applied, and shows strange results. For instance, a bar of railroad iron 30 feet long, if placed in the open cannon's mouth, cannot be drawn out by all the many men that can grasp it. Another instance of the strength of this big magnet was illustrated with a 350-pound cannon ball. The shot was placed in the mouth of one of the cannons, the negative side of the magnet. On reversing the electric current it fell from its position, but was attracted to the opposite cannon and clung to its side. The positive current was then reversed alternately with the negative, and the heavy cannon ball played between the two cannons like a tack between the poles of a toy magnet.—*Boston Herald.*

The New Observatory on the Säntis.—A new meteorological station and observatory has been opened on the Säntis, the highest mountain in the canton of Appenzell. The observatory has been placed about 2,500 metres (8,200 ft.) above sea-level, and is consequently the third highest observatory in Europe, the most elevated being that on the Sonnblick (3,090 metres, or 10,135 ft.) in the Salzburg Alps, and the next highest that of the Pic du Midi (2,859 metres, or 9,378 ft.) in the Pyrenees. The building, which is 26 ft. long, 20 ft. deep, and 30½ ft. high, is constructed of limestone blasted *in situ*. It contains, on the ground floor, the telegraph-office and the work-room of the resident observer, kitchen, and pantry; in the first story, living and bed-rooms for the observer and his assistant; in the second story, work and bed-rooms for *savants* staying for a time in the observatory for special investigations, and a store-room. In the second story, the barometer and barograph have been mounted. The flat roof of the building (of wood-cement), which rises but a few feet above the upper plateau of the summit, is stated to be well suited for observations in the open air. On the whole the building, which has been erected at an expense of about 60,000 fr., including the furniture, is said to answer its purpose admirably, and offers a better guarantee of correctness of the observations and registers kept than the former station in the châlet, about five miles below the peak.

Earthquake in the West Indies.—The Grenada papers report the occurrence in that island on the morning of the 10th of January of an earthquake, which, for violence and length of duration, was pronounced to be unprecedented by any similar phenomenon in the neighbourhood. The sound which usually accompanies an earthquake was immediately followed by a slight shock and gentle lateral oscillation; then came a very violent shock and vertical undulating oscillations that made the roof of every house creak and groan, and the walls threaten to crumble to the ground; these were succeeded by other gentle oscillations, which continued until the phenomenon ceased. The duration was computed to have been 20 or 30 seconds, and considerable damage was done, several houses in the town of St. George's being condemned as dangerous to reside in. The walls of the St. David's Roman Catholic Church were so seriously injured that they would have to be taken down in some places and rebuilt, and the sacristy was all but demolished. The basement wall of the Presbytery was thrown down, and the building itself had to be propped up with posts. The Court-house in the same parish sustained considerable injury. The tower of the Anglican Church in Grenville was cracked. During the succeeding week several mild shocks of earthquake were experienced in the island, the strongest of which occurred between seven and eight o'clock on the night of Sunday, the 15th.

Earthquake in Scotland.—An earthquake shock was experienced on the 2nd inst., over a considerable portion of the Scottish Highlands. The shock occurred about five o'clock in the morning, and the wave seems to have passed from the west to the east coast, beginning south of Fort-William, and terminating at the Inverness and Dornoch Firths, and affecting Inverness, Nairn, Beauly, Tobermory, Crieff, Dingwall, and other districts. Two distinct shocks are reported as having occurred at Crieff—one at half-past three o'clock and the other about five. In Strathglass, houses were terribly shaken and great terror caused among the people. In the upper end of the glen articles of furniture were displaced in several houses, which were hurriedly vacated by the inhabitants. The driver of the Strathglass mail coach states that when at breakfast about four a.m., dishes were displaced and furniture visibly shaken in his presence. In many of the houses at Fort William articles of earthenware and ornaments fell from their places to the floor and were broken. In one of the hotels a stag's head hanging in the hall vibrated, and when the shock passed remained in an oblique position. At Avenue Terrace several dishes fell out of a cupboard to the floor and were smashed. At Inverness hundreds of people felt the earthquake, and the steeple clock of the High Church was stopped at 5.5. This time exactly agrees with that stated by all who were aroused and looked at their timepieces. No damage is reported in town, with the exception of the falling of crockery ware. As the tremor seems to have followed the line of the Caledonian Canal, culminating in the valley of the Ness, it is interesting to remember the tradition of how in the year 1756, at the very time when the city of Lisbon was destroyed by an earthquake, the waters of Loch Ness were violently agitated, apparently moved by the same cause. Yet there is no record of this movement having been accompanied by any such motion of the land as that of last Thursday.

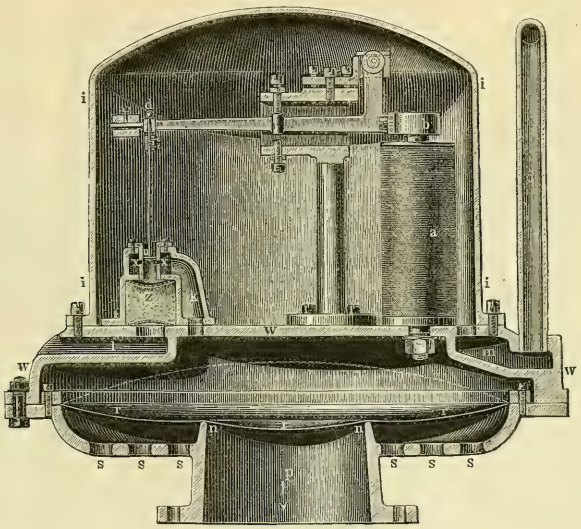
AUTOMATIC TEMPERATURE REGULATOR.

SEVERAL methods exist for keeping rooms or drying chambers at a constant temperature where gas is employed as the heating agent, but recently Messrs. Fischer and Stiehl, of Germany, have invented an apparatus for regulating automatically the temperature of rooms heated by ordinary fires. The principle of this regulator is that the whole of the air required for combustion of the fire is made to pass through the apparatus, so that when it is closed, the fire commences to go out. When owing to the fall in temperature, the ventilator is reopened, the fire again becomes brisk. The opening and closing of the air inlet is affected by means of an electric current.

In the room to be heated is placed a thermometer, having a platinum wire inserted in the bulb and another in the stem at the temperature desired. The bulb is connected with the regulator, whence a wire runs to a battery, and thence to the platinum wire in the stem. As soon as the mercury in the thermometer rises so as to close the circuit the damper is closed, and when the temperature falls the damper is again opened.

A sectional view of the regulator is given in our illustration. The damper consists of a sheet of gutta-percha *rrr* stretched over the opening *nn* of the air passage *p*, closing it hermetically. The space enclosed between the plate *www*, and the gutta-percha sheet is in communication with the chimney by means of the passage *m* and flue *o*. As soon as a current of air is established in the chimney, the sheet is raised to the position indicated by the dotted line, and a current of air passes through the holes *s* and pipe *p* to the fire. If the communication with the chimney be cut off, and the space above the gutta-percha sheet be placed in communication with the outside air, the sheet will fall and again close the air passage.

The alternate opening and closing of the communication is effected by the electro-magnet *a*.



THE STRUGGLE FOR EXISTENCE.

IN his customary clear and incisive style Professor Huxley has contributed a most thoughtful and suggestive article on the above subject in the February number of the *Nineteenth Century*. His conclusions too appear to us of an eminently practical nature, and are closely allied with the question of technical education, now occupying the minds of so many amongst us. Whether our struggles and misfortunes in the world are due to our being in a state of probation, as many suppose, or whether the evolutionist doctrine that they tend to final good, and that "the suffering of the ancestor is paid for by the increased perfection of the progeny," we need not discuss in these columns. Firmly as we believe in evolution as a process of natural selection, we think Professor Huxley does well to point at a somewhat popular error of imagining that evolution signifies a constant tendency to perfection. It may just as well be retrogressive as progressive.

In dealing with some of the more practical questions involved, Professor Huxley points out that in round figures the population of our island is 36,000,000, and that the yearly increase is considerably over 300,000. In other words, "about every hundred seconds a new claimant to the common stock of maintenance presents him or her self among us." The produce of the soil, however, does not provide food enough for half the population, and the other half must be fed with food derived from other countries in exchange for industrial products which

they want, and which we can produce better or more cheaply than they can.

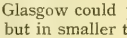
Our chances of preparing industrial products better or cheaper than those manufactured by competing nations must depend chiefly on the greater knowledge, skill, and industry we can bring to bear on their production without a proportionate increase in the cost. This naturally leads us to consider how we can best secure increased knowledge and skill, and on this point Professor Huxley makes some useful remarks, with all the greater authority because for many years he has been an acknowledged leader in the movement for teaching elementary science to the working classes. With pardonable pride he states that the Science and Art Department has done more in this direction during the last quarter of a century than any organisation which exists either in this or in any other country. At the same time he frankly admits that it exhibits the defects of all our educational systems—it has too much to do with books, and too little to do with things. Not that he would narrow early education and make the primary school a mere annexe of the shop; but he endorses "the common complaint against the bookish and theoretical character of our primary instruction."

We are pleased to find that he lays great stress on the importance of drawing, as a training for both the eye and hand. "Artists are born, not made; but everybody may be taught to draw elevations, plans, and sections; and pots and pans are as good, indeed better, models for the purpose than the Apollo Belvedere. The plant is not expensive; and there is this excellent quality about drawing of the kind indicated, that it can be tested almost as easily and severely as arithmetic. Such drawings are either right or wrong, and if they are wrong the pupil can be made to see that they are wrong. From the industrial point of view, drawing has the further merit that there is hardly any trade in which the power of drawing is not of daily and hourly utility." Then again, as to the teaching of elementary science as an element in general instruction, he points out how much may be done with the commonest and simplest of apparatus: "A candle, a boy's squirt, a piece of chalk may be made the starting points whence children may be led into the regions of science as far as their capacity permits, with efficient exercise of their observational and reasoning faculties." Much, however, must depend on the teacher, and "if object lessons often prove trivial failures, it is not the fault of the object lessons, but that of the teacher, who has not found out how much the power of teaching a little depends on knowing a great deal, and that thoroughly." We note by the way that Professor Huxley greatly blames "the detestable system of training teachers which is widely prevalent." He adds: "The memory loaded with mere bookwork is not the thing wanted—is, in fact, worse than useless—in the teacher of scientific subjects. It is absolutely essential that his mind should be full of knowledge, and not of mere learning, and that what he knows should have been learnt in the laboratory rather than in the library."

Dealing more directly with technical education, he considers it a necessity, not only because the old apprenticeship system has broken down, but because invention is constantly changing the face of our industries, so that "rule of thumb is gradually losing its importance, while that knowledge of principles which alone can deal successfully with changed conditions is becoming more and more valuable." He points out that one method of imparting technical instruction is to have technical schools, with a systematic and lengthened course of teaching, requiring the whole time of the pupils. Such schools, however, are very costly, and Professor Huxley urges that for artisans there must be classes, especially evening classes. Many such classes already exist, and are largely attended with the best results. The pressing need now is how to find means to extend them. Granted that it may be needless, and even unjust, to make education compulsory in a thinly populated agricultural district producing abundance of food, the opposite is the case in a densely populated manufacturing district, where the struggle for existence is very keen, and where every ignorant person is more or less a burden upon his fellows. Under such circumstances, says Prof. Huxley, "an education rate is, in fact, a war tax, levied for purposes of defence." He cannot see any objection to taxation for purposes of general education, but for technical schools and classes he thinks the taxation should be local. "Our industrial population accumulates in particular towns and districts; these districts are those which immediately profit by technical education; and it is only in them that we can find the men practically engaged in industries, among whom some may reasonably be expected to be competent judges of that which is wanted, and of the best means of meeting the want."

Professor Huxley approves the principle of the Government Bill introduced last session, and thinks there was some misunderstanding as to the proposed function of the Science and Art Department. It was considered by many that the technical education of the country would have been too much under the Department, "but in reality no power of initiation, nor even of meddling with details, was given to that Department, the sole function of which was to decide whether any plan proposed did or did not come within the limits of technical education." Such towns as Manchester, Liverpool, Birmingham, or Glasgow could probably be left to decide for themselves, but in smaller towns there would be less certainty of the matter being properly dealt with.

The struggle for existence involves many complex questions, such as wages, industry, social stability; and all of these are touched upon by Professor Huxley, briefly, but with considerable breadth of view, and we commend his article to all who wish to understand the true bearings of the case. Our own remarks have reference more particularly to the *technique* of the subject, and we trust that the extracts we have given will lead our readers to consult the original.



THE GELATINE WATER CARTRIDGE.—The fatal results o blasting with gunpowder in coal mines of a fiery character have been shown so often that the practice has been abandoned in scores of pits, and recourse has been had to wedging and other mechanical means for getting down the coal. But, the manufacturers of explosives have never ceased in their endeavours to find some cartridge which would exercise a rending action as great as or greater than gunpowder, and yet one which could be fired with safety in an explosive atmosphere. These results appear to have been attained by the employment of Nobel's gelatine dynamite in Settle's water cartridge. Thousands of such cartridges have been fired in daily practice, and in no case has either spark or flame been seen, while hundreds of special tests have been made under the eyes of trained observers with a like result.

Natural History.

AFRICAN SHEEP IN THE BERLIN ZOOLOGICAL GARDENS.

THEIR essential characteristic is that they are not covered with wool like their European relatives, but have stiff, coarse hair. There is a diversity in their size and shape, which alters according to the food and climate of the different places in which they are raised.

Sometimes the profile of the forehead is straight, but frequently it is more or less curved. The ears differ in length and breadth, in some animals standing out, and hanging down in others, while the body is more or less curved on the sides. The length and strength of the legs and tail are also varied, the latter in some species showing a tendency toward clumsiness in size.

The colour of these sheep is always black and white, the white forming the groundwork for the black round spots, which are found upon the nose, the eyes, ears, and just above the hoofs. The shape of the specimen shown in our illustration is rather small and graceful, the profile is straight, the finely-shaped ears stand out horizontally from the head, the line of the back is even, and the tail is a medium length. The body is curved, the limbs are slender, very similar to those of the deer.

The hair is short and even, except of the buck, and even then it grows long only on the under side of the neck. The large coloured spots which are distributed about the body are essentially black and characteristic. The Cameroon sheep are only useful as food, but they are considered of great importance among the black population, on account of their easy fattening qualities — *Illustrirte Zeitung*.

AFRICAN SHEEP.

THE EXTINCTION OF THE BISON. — The report of the Secretary of the Smithsonian Institution at Washington for the past year refers to the extraordinary difficulty with which specimens of the bison, or American buffalo, were obtained for the museum. In 1886 it was noticed that the representatives of the species in the museum were very defective, and it was decided to secure at once at all hazards, before the animal was wholly exterminated, a complete series of fresh skins and skeletons. The chief taxidermist was directed to set to work at once, but his inquiries were met by the assurance that the wild buffalo were all gone except in Yellowstone Park. Eventually reports were received that a few remained in Montana and a few in Texas. It was decided not to wait for the ordinary hunting season, but to start at once. About 75 miles north-west of Miles City, Montana, a herd of 50 to 60 buffalo was discovered. The residents along the Missouri and Yellowstone rivers were quite ignorant of the existence of the herd in these wild and uninhabited regions and it had found safe shelter there ever since the destruction of the great northern herd in 1881-83, and was breeding in fancied security. But the settlement of the country by ranchmen which had just

taken place doomed every one of these animals to destruction, and the sequel showed that the Smithsonian officials were only just in time to snatch a few specimens from the total annihilation that has overtaken millions. Three buffaloes were taken in this expedition, and later on in the year 22 more were killed and preserved in excellent condition. The series of skins and skeletons thus made are described as being now "of almost priceless value" when the last of the *Bos Americanus* is practically slaughtered. So rapidly are the great game animals of the United States disappearing, that "it is a sad certainty that in a very few years the elk, mountain sheep, goat, deer, moose, and other forms will have totally disappeared."

Fecundity of Pigs.—The natural fecundity of the pig is astonishing. They live and multiply in every country in the world, with the exception of the polar regions. If permitted, their natural life will extend to fifteen or twenty years, and they commence breeding when they are nine or twelve months old. An estimate was once formed of the probable production of a sow during the space of ten years. Only six young ones, male and female, were allowed for each litter. The result was that in eleven years the estimated product of a single sow was 6,434,838 pigs. At different times there have occurred many instances of remarkable fecundity. In Leicestershire a sow produced 355 young pigs in twenty litters, and afterwards produced eight litters more.

The Teredo and its Doings.—In many places where wooden piles have to be used to protect the mouths of harbours, great trouble is experienced in defending them against the attacks of the teredo. This is especially the case at San Francisco, where nearly half the gross income of the Harbour Board appears to be spent in repairing and renewing these structures. A variety of devices have been proposed and tried, but so far with but little success. The piles have been saturated with a variety of poisons, including carbon disulphide. They have been coated with various coal-tar and petroleum products with sulphur China clay, gypsum and cements. But these prepared piles have not resisted the enemy better than unprepared wood-work. Eucalyptus piles have failed completely. Cedar wood (that is, we presume, not the true cedar of Lebanon, but a species of juniper known in America as cedar) appears to have given the best results. Next to it seems to come the yellow pine. Teak-wood, which is not relished by insects, does not seem to have been tried.

Formation of Humus by Animal Action.—Herr. C. Keller, during a residence in Madagascar, has studied the formation of vegetable mould by worms. He has discovered a new species of earth-worm (*Geophagus Darwinii*), which is particularly active. It presents more the aspect of a snake than of a worm, being nearly an inch in thickness and 32 inches in length. It feeds on fresh and decayed leaves. In the course of half an hour one of these worms passed through its body nearly 4 ozs. of moist earth. Its "casts," which generally take the form of a tower, weigh as much as 5 ozs. Such a heap may reach $2\frac{1}{2}$ inches in height. These masses are to be found in the forests of Madagascar, not singly, but so plentifully that baskets might be filled with the comminuted earth. Thus in tropical climates the movement of the soil effected by worms is incomparably greater than that which has been observed in England. In the island of Reunion wood-lice join in the work, and on coral-reefs and in the Mangrove districts crabs take an important part in the movement of the soil.

Poisonous Butterflies.—Dr. Kappler, in a paper on the Monkeys of Dutch Guiana, states that when the squirrel-apes (*Chrysobryx sciurea*) "ate insects, they did not seem to know how to distinguish the poisonous ones; and three of them died from eating the wrong butterflies." Several species of monkeys feed not only on insects but on birds' eggs, and sometimes on young birds. The author mentions that such broad streams as the Amazon, Orinoco, and Rio Negro seem to make a separation between mammalian species.

Wanton Slaughter of Birds.—A correspondent of the *Newcastle Chronicle* states that in a Gloucestershire town during Christmas week he saw "bunches of small birds exposed for sale as food. Some were chaffinches, but the great majority of the little victims were young goldfinches of the year." Truly there is need for the activity of the Selborne Society. Strings of starlings have also been seen exposed for sale in a game shop. At Amble a bittern was seen on January 3rd, and was, of course, shot. This bird is useless as food, perfectly harmless, and is slaughtered out of pure wantonness.

A Nest-Building Fish.—According to M. Vaillant, *Antennarius marmoratus*, a curious fish studied by Agassiz, builds its nest of seaweed, the different parts being brought together and made fast to each other by means of a pasty substance secreted by the fish. Agassiz thought that separate bits of seaweed were used, but M. Vaillant has shown that it employs the whole of the branches of a single plant.

Habits of the Blackbird and Starling.—We learn from a northern contemporary that this fine songster is not to be trusted in an aviary. He has been known to peck thrushes to death and scalp them, though it is not stated that he eats any part of the bodies. The same authority states a starling's nest with young ones was found at Ellerton-in-Swale, in the earlier part of January. According to the Rev. T. Londsborough, of Kilmarnock, this bird was fifty years ago looked upon as a rarity in Scotland.

Structure of the Muscles of the Mollusca.—M. H. Fol, in a communication to the French Academy of Science, proves that true transverse striation does not exist in the muscle-fibres of any molluscous animal. In this class we meet with only one type of muscle, that with smooth fibre.

A Phosphorescent Earth-worm.—M. A. Giard has observed at Wimereux, near Boulogne, a true phosphorescent earth-worm, which seems to be abundant during the months of August and September. Their light is quite as intense as that of the glow-worm (*Lampyris*), which is well-known to be a beetle.

Cave Animals of North America.—Professor A. S. Packard enumerates 172 species of blind creatures found

in the caverns of North America. Nearly all of them are white over the greater portion of their bodies.

HABITS OF CROWS.—According to the *American Naturalist* the crow (*Corvus Americanus*) makes itself troublesome in winter, pecking holes in the backs of swine, and in some cases eating away their ears. The magpie in Nebraska is guilty of similar conduct.

HYBRIDS BETWEEN THE DOG AND THE JACKAL.—Experiments, carefully conducted in the Zoological Garden of the Agricultural Institute of the University of Halle, since the year 1881, have proved that hybrids between the jackal and the domestic dog are capable of reproduction, not merely with individuals of pure blood, but among themselves. This is a fact of great importance in support of the doctrine of organic evolution.

THE KOLA-NUT.

THE preparations of the kola-nut are among the most important of our recently discovered drugs. For ten years Mr. T. Christy, F.L.S., of London, has been devoting his attention to the properties of this West African plant. According to Dr. Nachtigall the kola-nut has been for generations looked upon as a sacred symbol in the interior of Africa; for some time it has been extensively used there to make an excellent beverage; but now its preparations are expected to be of national as well as social importance. Mr. Armstrong, when working with kola, discovered that it was of great help in clarifying and greatly improving beer. MM. Heckel and Schlagdenhauffen have proved that it renders innocuous the most foul waters, and makes tainted meat edible. A Fellow of the Linnæan Society declared from his own experience that the foreman of his estate was in the habit of getting the worse for drink every Saturday, but that shortly before his services were required on the Monday mornings, his wife used to reduce a kola-nut into a paste, which the man was made to swallow, and in half an hour he was all right again. At some of the garrison towns situated on the West Coast of Africa, a native sits at the roadside and sells the nuts as the men pass; these nuts are chewed, and by the time they reach the barracks, they are quite clearheaded, and the stupefaction caused by drinking spirits is gone. Some who have used the nut-paste as a "pick-me-up" assert that, while removing the well-known nausea, it gives them a strong dislike to the smell of spirits for some days. But it is in the paste and chocolate forms that it will be found of greatest advantage. If the paste is mixed with cocoa, it gives a chocolate of a superior and finer quality. Chocolate made with kola-paste is five times more nutritious than chocolate made with cocoa. A working man can, on a single cup of kola-chocolate taken at breakfast-time, go on with his work through the day without feeling fatigued. Though it may not directly feed the muscular system, it has the property of preventing the rapid waste of the tissues. So much have the manufacturers of chocolate, both in this country and on the Continent, become alive to the excellent properties of the new paste, that they are making arrangements to procure it for mixing purposes, as soon as its price becomes reasonable. The British Government, too, have gone the length of undertaking to test and experiment with it, so as to ascertain the saving which would be made in the transit of provisions in time of war by giving this beverage to the army.

Professor E. Heckel, the discoverer of the process for producing the paste from the nut, is quite sanguine about its marvellous nutritious and strengthening qualities. Dr. V. A. Stok, military doctor in the Netherlands army, is convinced that it can produce a very good drink for the army and navy hospitals. It has been used with great service in dysentery and diarrhœa, and in all cases of nervous depression. Dr. Hudson, medical inspector of the United States navy, has successfully used it to remove the severe headaches and dyspepsia in certain forms of heart disease. Dr. A. L. Gihon, medical director of the United States navy, found its properties most valuable in an extreme case of neurasthenia. After failing with quinine, arsenic, iron, bitter tonic, guarana, and diffusible stimulants, the kola-paste quickly made a change on the patient. The violent headaches did not return, the appetite was recovered, muscular vigour regained, and the mental dejection markedly relieved. The medical profession in the United States has given it a fair trial, and have acknowledged it to be a first-class remedial food product. Several hospitals on the Continent are using it; and Dr. T. Oliver writes to the *Lancet* that cases of mitral regurgitation treated by him have received much benefit from it. As a food product its sustaining and stimulating properties have earned for it a large consumption by those who have been fortunate enough to have tried it. Mr. A. E. Floyer, the superintendent of the Government telegraphs of Egypt, considers kola-chocolate excellent for expeditions. He and his servant did ten hours' very severe climbing, slept on the rocks, did ten miles more next day, and arrived at the camp in capital spirits, though all their nourishment during that period was (between them) four biscuits, three oranges, and three tablets of kola-chocolate—practically nothing but kola. A cup of kolatina taken at breakfast or at supper-time regularly, or a cupful between meals, will produce a beneficial and stimulating effect on the system, replacing the craving for drink, and finally curing the patient of dipsomania. The great advantage in its use for this purpose is the fact of its being pleasant to the taste, and in the patient taking it without suspecting why it is administered. For frequently recurring headaches, whether of the bilious, uræmic, nervous, or neuralgic type, kolatina is invaluable. For weakened digestive organs it is superior to anything else. Travellers, city men, reporters have found it to be an inestimable boon, a cupful giving renewed vigour to the brain, and dispelling any ill-effects of a continued strain on the mind or body. That the excellent results obtained with kola-nuts will create a large and increasing demand has already been proved, as an order has been lately received by Messrs. Christy and Co. for forward delivery of no less than twenty tons of the nuts.

The native country of the kola tree (*Cola acuminata*) is the western territory of Africa. It grows thirty feet high, with broad leaves six inches long. In its fifth year it begins to yield a crop, but it reaches its maturity in its tenth year, when it yields 120 lbs. of seed. The flowering is nearly continuous, fruit and flowers being on the tree at the same time, as there are two crops every year. When ripe the fruit is of a brownish yellow colour, and in this condition the capsule opens, and discloses red and white seeds or nuts in the same shell. The gathering of the seeds then commences.

These big pods are about $3\frac{1}{2}$ inches long, and 2 inches thick. From a single flower as many as half a dozen of ripe carpels may be produced, and these may contain from five to fifteen nuts or seeds. These seeds weigh from 80 to 400 grains; that is, from about eighteen to ninety seeds to the pound weight. Women gather the seeds with great care. They are removed from the husk and skinned, and considerable attention is necessary to keep them in a fresh state. Mr. Christy very kindly sent us specimens of the fresh nut, the dry nut, the paste, kolatina, and kola-chocolate; and he particularly mentioned that the fresh nuts should at once be put into brine for preservation. When the women thoroughly clear them, the sound seeds are carefully placed in large baskets made of bark and lined with large "bal" leaves. In these baskets the kola seeds are carried great distances inland, but they require repacking every thirty days. Each package contains about 3 cwt. of seeds. In this condition the kola is transported into Gambia and Goree, where the principal dealings in the seeds are carried on. The Gambia merchants dry them in the sun and reduce them to powder, which is used, mixed with milk and honey, by the tribes of the interior to make a very agreeable, stimulating, and nourishing beverage. As the kola makes its way inland its value increases, and some of the tribes furthest removed from the sea pay for the dry powder with an equal weight of gold dust.

Kola plays an important part in the social life of many of the African tribes. An interchange of white kola between two chiefs is indicative of friendship, whilst the sending of red kola is an act of defiance. An offer of marriage is accompanied by a present of white kola for the young lady's mother, the return of white kola means acceptance, whilst red means rejection. The absence of kola from the marriage presents would endanger the whole arrangement. All the oaths are administered in the presence of kola seeds; the negro stretches out his hand over them whilst he swears, and eats them afterwards. Care has to be taken in distinguishing the female from the male kola trees for purposes of medicinal use, as the false kola is bitter and useless.

A comparison between the composition of kola, tea, coffee, and cocoa shows that the proportion of caffeine is higher in kola than in any of the others, and it has more theobromine than cocoa. The average quantity of caffeine in kola is about $2\frac{1}{2}$ per cent. Now this alkaloid (having thirty per cent. of nitrogen) has the remarkable property of diminishing the waste of the animal frame. The introduction into the stomach of three grains of caffeine, or the contents of one small nut, has the wonderful effect of sensibly reducing the decay of the system. Consequently the necessity for food to repair it will be lessened in equal proportion. This caffeine in the kola is very active, exercising an exhilarating and soothing, hunger-stopping, and waste-diminishing effect upon the human frame.

The results of the experiments which are now being made in the Government laboratories, in hospitals, and chocolate establishments at home and abroad, are anxiously looked forward to. But enough has already been discovered to show that the kola-nut must yet be an important article of commerce, a fruitful produce for our Colonies; and the sooner our planters cultivate it to meet the growing demand, the better it will be for them; otherwise they may be again outstripped by the dashing enterprise of our Continental rivals.

JAPANESE MAGIC MIRRORS.

THESE interesting examples of Japanese work are circular metallic hand-mirrors, having figures in relief on the back. The reflecting surface is highly polished, and reflects the face as well, apparently, as mirrors of silvered glass; but when it is used to reflect the direct rays of a powerful light upon a screen, the reflection shows, with a moderate degree of distinctness, the figures that are at the back of the mirror. This phenomenon is popularly ascribed to the marvellous ingenuity exercised by the Japanese metal-workers in the production of the mirrors, but from a paper contributed to the Franklin Institute by Mr. F. E. Ives it is capable of a very simple and satisfactory explanation. The mirror experimented on is described as being thin, made of very elastic metal, with the polished face slightly convex, and with the general form of the back slightly convex, measured from the top of the ornamental relief figures and rim. Mr. Ive's idea is that the mirror is simply cast (not stamped, chiselled, or hammered), and that the apparently magical reflections are produced merely in the ordinary process of grinding and polishing. For if, in the operation of grinding the face of the mirror, it be held against the grinding surface by a flat support at the back, the pressure would flatten it until the ornamental relief figures rested upon the support, and on those parts the mirror would offer a positive resistance and be ground away rapidly; but the thin parts between the relief figures, having no direct support, would be sprung back by the grinding pressure, and would therefore be ground away less rapidly. On removal of pressure the back of the mirror would regain its original form, but the face, ground away irregularly, and most where the relief at the back was greatest, would have a slight but irregular convexity, greatest on the thin parts between the relief figures. Mr. Ives attributes the pattern produced in the reflection to this irregular convexity, and tested the truth of his explanation by adopting means to render the mirror face perfectly flat, when, of course, if his theory were correct, the pattern would vanish from the reflection. This flattening was accomplished by superimposing on the mirror a heavy piece of plate glass, with the result anticipated. The figures vanished from the reflection, and the credit given to Japanese mirror-makers for mystical workmanship seems to have been undeserved.

WALKER'S PORTABLE MINER'S ELECTRIC LAMP.—This lamp is at present made in two forms. In one, which is round, are two cells of a bichromate-carbon-zinc battery; in the other, an oval one, there are three. The cells are made in a particular form, the carbon itself being the containing vessel. On one side is a strong lens faced by a parabolic reflector, the two being held by a strong brass cylinder attached to the outer case, which is also of brass or copper. The cells contain the usual porous cells and zincs, and are closed by an india-rubber pad, above which the connections are made in a simple and efficient manner. A second pad of indiarubber is placed above this, and is retained in its place by the cover, which is held by screws, or a lock, as desired. A stout handle surmounts the whole. The smaller lamp, made of a cylindrical form, weighs 5 lbs., and gives a light sufficient to read ordinary newspaper print at 6 feet from the lamp for ten hours. The cost of renewing the chemicals used, the incandescent lamp, and incidental repairs, is stated to be not more than $\frac{3}{4}$d. per day for the small lamp, and 1d. per day for the large one.—*Electrical Review.*

Reviews.

Our Earth and its Story. Edited by R. Brown, Ph.D., etc. London : Cassell and Co., 1887.

There is room even in these days for a popular treatise on Physical Geography, and a book like the one before us, brave in all the wealth of its 376 pages, its twelve coloured plates and maps, and 200 woodcuts, may well claim a place in the library of those who lack time, energy, or inclination to wrestle with the many text-books from which it draws it stores of information.

To tell the truth, we opened Dr. Brown's book with an old dislike of knowledge made easy, blinding us to its outward graces ; we close it with a feeling that for once knowledge has been made easy without being made at the same time misleadingly superficial, and with a conviction that its influence will go towards forming inquirers and students rather than scientific dilettanti and prigs.

Sound, Light, and Heat. By Mark R. Wright. Longmans' Elementary Science Manuals. (London : Longmans, Green, and Co. 1887.)

As a guide for the beginner it would be hard to find a better book than the one before us. The subjects are treated experimentally, and the illustrative experiments are well-chosen, simple, and do not require elaborate apparatus ; indeed the apparatus suggested not unfrequently reminds us of Faraday's, for he, with the aid of a few test-tubes and corks, and some tubing, did work which still puts to shame that carried out in many an expensive laboratory. A student who goes carefully through the experiments given in Mr. Wright's book will find himself at the end of it in possession of a solid foundation of the best kind of knowledge—that derived from actual personal experience—and upon it he may safely build as far as his powers and opportunities permit. Even if he builds no further, he will always have a firmer grasp of facts and be better able to appreciate inductive reasoning, for having submitted himself to such a discipline of experiment.

The Commonhealth. A Series of Essays on Health and Felicity for Every-day Readers. By Benjamin Ward Richardson, M.D., F.R.S. London : Longmans, Green and Co.

"Health and felicity?" Blossoms withering in the smoky breath of modern "Industrialism?" We fear so. But by what pure dew or what sunlight are they to be revived? Our author points out ably and eloquently many shameful evils, many points in which, despite all sanitary reforms, men and women fall immeasurably short of the normal type of their nature. He asks, "Where is there a healthy child?" Recognising that "our children under five years are expected to die in what may almost be called a definite proportion," he declares that "for this we have no shame." But where is the practicable remedy?

It may sound cynical to say that room and nutriment throughout nature are found for existing plants and animals merely by the premature death of a large proportion of the individuals produced. We speak with too much truth of the "unemployed." But what would be their numbers if every child born should live on to the age of three-score and ten?

Yet there is a remedy, one which we have in our humble way proclaimed for years, and which we are glad to find insisted upon by Dr. Richardson, with more eloquence and more authority. It is not what is called Malthusianism. It is expressed by our author in these words :—"Let hereditary health be once recognised as an element—we would add a necessary element—of the marriage contract, and the health and life of the nation will receive a lease that shall double the value of the one and the duration of the other." The ancient laws of the Buddhists, we learn, decreed that if man or woman had unwittingly married into a family tainted with scrofula, consumption, or other hereditary disease, he or she might sue out a divorce. There are certainly passages in this essay on the "Seed-Time of Health" with which we do not feel able to agree. For all this we would advise our readers to study it thoughtfully. It will be better for them.

In the chapter on "Health and Recreation," he points out the necessity of removing "the idea of the distinction of labour and pleasure, the morbid notion that some must work and some must play that the world may make its round." He might here have remarked that "labour," "industry," so much extolled in these days, are too often mere euphemisms for greed, just as among our savage forefathers cruelty and rapine were veiled under the names of courage and patriotism.

Dr. Richardson's view of recreations reminds us of the paradoxical but truthful saying of Sir G. C. Lewis, that "life would be tolerable but for its amusements." Very wisely does our author, starting from pure physiological considerations, reject as recreations "all games in which what are called *stakes* are played"—"I know of little that has been a worse physical scourge to the human race than this system of using recreation for the purpose of winning or losing . . . Health and chance are incompatibles." If we are asked why, we should reply, "because chance involves anxiety, and anxiety is, perhaps, the most deadly form of dissipation."

From considering these disastrous effects of anxiety we pass naturally to the greatest cause of anxiety in boys and young men, competitive examination. Here we must let Dr. Richardson speak for himself: "To the errors which are thus cultivated by the crush of education in early life, and which breed a dislike for education in after-life, there is added, in our modern systems, another error, that of making learning, which should be quiet as a murmuring stream, competitively furious. I confess I stand daily appalled at the injury to mental and physical life which I see being perpetrated by competition in the name of learning. Thirty years ago matters were getting bad, now they are getting hopeless. At that time one sex at all events was safe from the insanity. Women were saved from the competitive mental strain, so that the progenies that were to come were born with promises of safety, on the maternal side at least, from mental degeneration. Now, however, women are racing with men in strife to find out who shall first become mentally enfeebled and crippled first. . . . At this time we find a great many men still writing useful books, making discoveries in science, and, in a word, keeping alight the intellectual fire. Who are these men? We read their lives and find that they are, I had almost said without exception, men who in their early career had been under no competitive pressure. Who are to follow these? In the upper and middle classes dearth cannot but remain while the current method of encouraging mental death by competitive strife is the fashionable proceeding. I can find numbers of men who, having been born with good natural parts, have been turned into imbeciles by severe

competitive strain; but I challenge the production of even one man of pre-eminent and advanced power who has been brought out in complete and sustained and acknowledged mastery of intellect by the competitive plan. Competition has murdered mind."

This passage alone ought to secure for the work before us a wide circulation among all classes of this "examined" country.

But there is also much, very much else worthy of notice. Some of the author's proposed health-reforms may, indeed, savour of Utopia, yet in the above quoted passage he points to a sanitary reform which would cost nothing and which could be accomplished at a blow.

The Story of the Niger. Illustrated. London: T. Nelson and Sons.

In this attractive little volume is told the story of the mysterious river from the days of Mungo Park down to the present time. It is a story full of interest and of suggestiveness too. We seem in reading it to see ahead of us some such vision as that of Winwood Reade—a vision of the time when "the cockneys of Timbuctoo have their tea-gardens in the oases of the Sahara; when hotels and guide books are established at the sources of the Nile; when it becomes fashionable to go yachting on the lakes of the Great Plateau; when noblemen, building seats in Central Africa, will have their elephant parks and their hippopotami water; young ladies on camp-stools under palm-trees will read with tears 'The Last of the Negroes,' and the Niger will become as romantic a river as the Rhine." But the time is not yet, and meanwhile many boys, even those of larger growth, will find pleasure, and possibly profit, from this concise account of what has been achieved by great explorers of the past and present.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Thirty-first Session. 1887-88.

This issue contains an account of an improved riveting machine, by Mr. Hugh Smith; of a paper on Copper and Copper Castings, by Mr. G. C. Thomson, F.C.S.; and Experiments on the Strength of Copper Steam-pipes made at Lancefield, by Mr. Nisbet Sinclair.

Mr. Thomson mentions that arsenic and silver are almost invariably present as impurities in copper; that bismuth is also very commonly present, except in copper obtained from Australian and Siberian carbonates; that antimony is less frequently present than it has been generally supposed, and that lead, though rare in cake-coppers, is almost invariably found in copper sheets and rods.

Proceedings of the Institution of Mechanical Engineers. September, 1887.

The papers read and discussed at this meeting were: "Experiments on the Distribution of Heat in a Stationary Steam-Engine," and "Supplementary Experiments on the Initial Condensation in a Steam-Cylinder," both by Major Thomas English, R.E. These papers are too purely technical to admit of examination in our columns.

MALLEABLE BRASS.—To make malleable brass, first melt 33 parts of copper in a crucible which is loosely covered, then add 25 parts of zinc—this must be purified by sulphur. —*Mechanical Progress.*

THE RATE OF ANIMAL DEVELOPMENT.—II.

(*Concluded from page* 137.)

OF course it would be somewhat unfair to demand of such men as Addison and Whewell that before attempting to theorise they should go forth to the forests of Borneo in search of facts. But surely every man in England, though he may never have met with infant apes, must have seen how kittens when beginning to walk, totter, stagger, and roll over, just like young children; how they pat at and endeavour to touch objects beyond their reach, and how, even after their fore-legs have gained a considerable degree of firmness and obey the will, the hinder extremities remain feeble, and are often for a time, trailed helplessly along. Thus, then, we see that in the class mammalia, man, instead of standing alone in sharp contrast to the rest of the class, merely occupies one end of a series at the other extremity of which rank our oft-mentioned friends the colt and the lamb, whilst the carnivorous animals and the apes come in between, the rate of development of each species being slower and slower as it approaches in its structure more and more nearly to man. Some very obvious reasons why such must be the case will follow in due course.

But what are the facts concerning birds? Are they all able as soon as they quit the shell to direct the beak with perfect accuracy, to select proper food and to flutter about, awaiting merely the growth of their wing-feathers to be able to fly? Davy's "Ornither" must have been either a wilful deceiver or an egregious goose. Had he been a careful and conscientious observer he must have been aware that what he affirms of birds in general is true in any sense merely of the poultry tribe, the waders, water-fowl, and the ostrich tribe, but assuredly not of the song-birds, the crows, the doves, the parrots, and the birds of prey. Did any of the authors we have referred to, after indulging in platitudes on "young ducks," ever take the trouble to look at a young hawk, a young thrush, or a young canary? Had they done so they would have seen that such nestlings, instead of being able to "direct the beak with the greatest accuracy," can merely sit in the nest with open mouth, waiting to be fed. A young canary, so far from being able to stand or hop, seldom fails to break its legs if startled and urged by fright to attempt leaving its nest. Such facts as these are known to every bird-fancier in the Seven Dials, and to every rustic youth who has robbed a nest and has then attempted to rear the callow young. They are not known, it appears, to men of learning. It was, we believe, the Prime Minister of Gustavus Adolphus of Sweden, who said to his son: "Thou knowest not with how little wisdom the world is governed." In like manner we know not with how little accurate, thorough knowledge books are written, imposing reputations built up, and the world is misinstructed.

Professor Whewell, of course, may be considered a type of those men whose knowledge is entirely derived from books. Still it might have been expected that he would some day have stumbled upon the following passage from good old Gilbert White:—"On the fifth of July, 1775, I untiled part of a roof over the nest of a swift. The squab young we brought down and placed upon the grass-plot, where they tumbled about and were as helpless as a new-born child. When we contemplated their naked bodies, their unwieldy disproportionate

abdomina, and their heads too heavy for the necks to support, we could not but marvel."

Davy and Whewell might further have found in Erasmus Darwin's "Zoonomia" (Vol. I., p. 187-194), some remarks on the different stages of growth which animals of different species have reached when first brought into the world. The author uses these words: "The chicks of the pheasant and the partridge have more perfect plumage, more perfect eyes, and greater aptitudes for walking, than the callow nestlings of the dove or the wren. It is only necessary to show the former their food and teach them to pick, whilst the latter for days obtrude a gaping mouth."

Prof. Whewell, being a German scholar, might have read how Lorenz Oken divided the class "birds" into the main groups "nest sitters" and "nest quitters" (nest-hocker and nest-fluechter), according as when hatched they remain helpless in the nest, or are at once able to run about and seek food for themselves.

Davy puts into the mouth of his "Ornither" a very lame explanation of the fact that most birds cannot fly as soon as hatched. Before they can take flight they have to await, not alone the growth of their feathers, but the development of the muscles. The fact that parent birds educate their young is clearly shown by the interesting observations of Dr. C. Abbott (*Journal of Science*, VI., second series, p. 361). He remarks: "With the simple growth of the wing-feathers there does not come the ability to fly. Just as creeping precedes walking in children, this is a gradually acquired power. The commencement may be termed 'flapping,' and consists in simply breaking the force of a descent; this is followed by a more effectual use of the wings and by horizontal progression, and it is some time subsequent to this that the young birds attain to the power of upward flight. . . . . When a sufficient growth of feathers has been obtained, the parent-birds directly and indirectly instruct them, or, perhaps, more properly force them to use their wings." He describes the manner in which a pair of indigo-birds forced their brood to fly, and the progress made by the nestlings in the course of five days. "Indirect instruction" is also given, the parents ceasing to bring food to the nest and thus compel the young ones to follow them. "Once out of the nest they soon endeavour to walk on air, as it were, and falling, open their wings, and thus take the initial step. This ceasing to bring the food to the young while yet in the nest is done, in some instances I judge, only to draw them from the nest; and then they feed them as before, but not so frequently, which leads the young to voluntarily move from point to point. In the case of birds of prey, the process is more prolonged, and the young are still fed by their parents after leaving the nest." For the training of young eagles we may refer to Deuteronomy xxxii. 11.

Dr. Spalding's observations on young swallows do not, in reality, controvert those of Dr. Abbott: "A young swallow will as little need instruction in flying, when its muscles are once developed, as does a chick is the art of walking."

Thus we see that the condition of young animals is analogous to that of the human infant. The child, indeed is still slower in learning to walk than the kitten or the young ape, not because he has to learn in a different manner, but because the development of his muscles and joints is still more gradual; because he has to support himself on one pair of limbs only, rendering his base narrower, and his centre of gravity higher from the ground. Finally, as we have already shown, the hinder extremities gain strength more slowly than the anterior.

Surely, therefore, the helplessness of the child is no exceptional fact, and the hypotheses built upon it by rhetoricians may be safely dismissed to dreamland, whence they came.

ARTISTS' COLOURS.

FROM the cochineal insect is obtained the gorgeous carmine, as well as the crimson, scarlet and purple lakes. Sepia is the inky fluid discharged by the cuttle fish, to render the water opaque for its own concealment when attacked. Ivory black and bone black are made out of ivory chips. The exquisite Prussian blue is got by fusing horses' hoofs and other refuse animal matter with impure potassium carbonate. It was discovered by an accident. In the vegetable kingdom are included the lakes, derived from roots, barks and gums. Blue black is from the charcoal of the vine stalk. Lampblack is soot from certain resinous substances. From the madder plant, which grows in Hindostan, is manufactured Turkey red. Gamboge comes from the yellow sap of a tree, which the natives of Siam catch in cocoanut shells. Raw sienna is the natural earth from the neighbourhood of Sienna, Italy. When burned it is burned sienna. Raw umber is an earth from Umbria, and is also burned.

To the vegetable pigments may be added Indian ink, which is said to be made from burnt camphor. The Chinese, who alone can produce it, will not reveal the secret of its composition. Mastic—the base of the varnish so called—is from the gum of the mastic tree, indigenous to the Grecian archipelago. Bistre is the soot of wood. Of real ultramarine but little is found in the market. It is obtained from the precious lapis lazuli, and commands a fabulous price. Chinese white is prepared from zinc. Scarlet is iodide of mercury, and cinnabar, or native vermillion, is a quicksilver ore.—*New Orleans Picayune.*

A GOOD THING FOR BOYS.

MANUAL training is one of the few good things that are good for everybody. It is good for the rich boy, to teach him respect for the dignity of work. It is good for the poor boy, to increase his facility for handling tools, if tools prove to be the thing he must handle for a living afterwards. The boy utterly unable, even if he were studious, to keep up in book knowledge with the brighter boys, becomes discouraged, dull, and moody. Let him go to the work-room for an hour, and find that he can make a box or plane a rough piece of board as well as the brighter scholar, nay, very likely better than his brighter neighbour, and you have given him an impulse of self-respect that is one of untold benefit to him when he goes back to his studies. He will be a brighter and a better boy for finding out something that he can do well. It is not planing the board that does him good; it is planing the board in the presence of other boys who can no longer look down upon him when they see how well he can plane. He might go home after school and plane a board in the bosom of his family, or go to an evening school to learn to plane without a quarter part, nay, without any, of the invaluable effect upon his manhood that it will have to let him plane side by side with those who in mental attainments may be his superiors.—From *Manual Training in Schools*, by Alice Wellington Rollins, in the *American Magazine* for January.

Abstracts of Papers, Lectures, etc.

THE ROYAL INSTITUTION.

On the 3rd inst. a discourse was given by Mr. Frank Crisp, on "Ancient Microscopes." In the library, on specially placed stages in the theatre, and on the lecture table, were some 600 microscopes of early dates, while on the tables of the library were shown many early books containing figures of microscopes. Among the works were Robert Hook, 1665, Adams with a plate of a solar microscope, Pierre Lyonet with a plate of a dissecting microscope, and a practical work by Adams, a maker, dated 1747. The collection of microscopes which Mr. Crisp has for so long taken such unstinted pains to collect, was unfortunately without any labels, so that their dates were not known to visitors. The first reference made by Mr. Crisp was to one of the latest productions of Powell and Lealand, as a type of our present perfection. Turning from this to the odd shapes of the early works, Mr. Crisp said he meant in his title by the word "ancient" any microscope made earlier than 100 years ago. We now look for clearness of vision, stability, and absence of all needless adornment. It is interesting to see from what our present work has been evolved. One striking point is that though we now make only of brass, the "ancients" made of wood, ivory, tortoiseshell, and papier maché. But they also excessively ornamented their microscopes. To illustrate this there was held up an elaborate stand for a really weak microscope made for Cardinal Lambartin, afterwards Pope Benedict XIV., where the silk linings and the large space for the papal insignia made the whole affair ludicrous in the eyes of a man of science. After others, belonging to Popes and distinguished people had been shown, a strange green coloured one made for George III. was held up. But, it was remarked, no good recorded work had come from any of these. They were like toys. In tracing stability for a microscope it was shown how long it took to acquire this. Some were placed on the table which a puff of breath blew over. At length there seemed to be acquired stability to such an excess that adjustment was difficult. It appeared to us now strange that it took so long for the right use of a mirror to be understood. The old way of getting a focus was really "barbarous." Some drawings of old microscopes were shown on the screen, odd pictures with tubes 5 feet long, and men standing on hillocks to use them. The explanation was that where an eye was at first used to indicate the point of observation subsequent draughtsmen put in the entire human figure, and so lengthened tubes for artistic effect. On the whole, however, we have to be thankful for what the ancients did, as from their work has come our modern powerful instrument.

INSTITUTION OF MECHANICAL ENGINEERS.

At the meeting on the 3rd inst. Mr. William Geipel read a paper on "The Position and Prospects of Electricity as Applied to Engineering." The author confines his remarks to those branches of electric engineering which involve the employment of considerable power and are in some way connected with the use of dynamo machines.

In the near future the electric transmission and distribution of power will probably occupy more attention and call forth more outlay of capital than any other branch of electric engineering. Owing to its simplicity, the ease with which an electric motor can be applied to any purpose requiring power, and its high efficiency, it is certainly an approach to an ideally perfect system of transmission.

Were it not for the cost of the dynamos and motors, electricity would supersede to a great extent the use of belts and shafting. In large works, where high speeds are required and the demand for power is variable, the efficiency of belts and shafting is very low indeed. As much as 25 per cent. of the power may be absorbed by the shafting when the full number of machines are in use; and in such a case with half the machines in use the loss of power rises to nearly 50 per cent., while in the extreme of driving only a single machine even 99 per cent. may be lost. With electricity, on the other hand, no power is being used in keeping the transmitting medium in motion, the conductor being stationary; the loss takes place only whilst power is actually being used by the motors, each of which drives its own machine. In fact, the percentage of power lost in the transmitting medium becomes smaller as the amount of power transmitted is reduced, which is exactly the converse of what happens with belting and shafting.

The depreciation of the electric conductors is comparatively small; but whether the saving of renewing belts and of lubricating shafting would not be counterbalanced by the wear and tear of motors, is a question to be settled by individual experience. The advantage, however, of getting rid of shafting, thereby obviating the necessity for additional stability in the building and doing away with constant lubrication, and the further advantages of saving the space and light absorbed by belts, and of the ease with which the conductor can be shifted to suit any desired alterations in position of machines, are also very important matters.

The distribution of power by electricity from a central station to small users will, in the author's opinion, form in many towns a larger business than the lighting. Both can be done from the same mains and generators, just as is the case with gas; it is merely a question of economy and convenience as to whether gas or electricity should be used.

An electric motor can be started and stopped at will with the greatest ease; it requires the smallest amount of attention, occupies the minimum of space, and can be placed in almost any position.

As small steam-engines are being superseded by gas-engines wherever the outlay for the latter can be afforded, the competition in regard to small powers lies between gas and electricity, and steam may be left out of the question.

In Geneva, within a radius of a mile and a quarter, there are no fewer than 175 electric motors at work, varying from ½ to 70 hp., supplying power to small workshops and for other purposes, the electric power being obtained from dynamos and turbines, which are driven by water power derived from the Rhone. The installation is paying its way, and is about to be largely increased. At the Falls of Niagara plant is being put down to distribute power obtained from the falls to neighbouring towns, including Buffalo, which is 20 miles distant; the amount of power is stated at 15,000 hp., of which 10,000 hp. is contracted for at £3 per horse-power per annum for power and lighting purposes in Buffalo.

Many schemes have been propounded for distributing power in manufacturing districts by means of steam, compressed air, and water pressure, each of which is in use to a somewhat limited extent; and as all of them have been known long enough, it may seemingly be inferred from their limited employment that there is not much to recommend their extended use commercially. With steam the condensation in the pipes causes loss of pressure, and results in wet steam being supplied to the engines. Compressed air cannot efficiently be worked expansively, and is attended with loss of heat in the compressor. Water pressure commonly involves using the maximum power, whatever the work required. Besides these prominent faults of the three several methods, what is of the greatest importance and common to all three is that the generating plant has to be used almost exclusively for supplying the power, and cannot be utilised for other purposes in addition; whereas, with a central electric station, the engines and dynamos serve to generate current for lighting purposes also at night. In collieries electricity will be largely adopted in the near future. For underground hauling, pumping, ventilating, and drilling it can be readily applied with an efficiency double that of compressed air. With a well-arranged installation, 75 per cent. of the brake power of the engine will be utilised on the shaft of the motor. For hauling and pumping, wire ropes or rods are the greatest competitors of electricity, which obviates the following disadvantages in connection with them :—chance of breakdown through strain; wear and tear; mishap to guides through falls of roof or dirt; trouble and expense of oiling the guides; and room required at pit mouth or at bottom for engine, pulleys or levers, or other gear. As the tendency in mines in this country is towards a reduction of working hours, the question of mechanical haulage becomes most important, because horses must be fed whether at work or idle, and the cost of haulage by horses therefore increases as the working hours become reduced.

For ventilating and drilling, compressed air is perhaps more largely used; and one of the great points in its favour is that the exhaust is available for supplying fresh air to the miners, and for driving out the foul gas after the firing of shots. But the cost of the compressed air machinery is heavy, as is also that of the pipes for conducting the compressed air from the compressor to the place where it is used. The cost of electric plant is somewhat less, and the efficiency is very much greater; while by using old haulage ropes as conductors the cost of this item is rendered very small.

Duprez succeeded in demonstrating practically that 52 horse-power could be transmitted over a distance of 35 miles, namely from Creil to Paris, through a copper cable equal in section to a wire of less than 0·2 diameter. But his machines were not efficient, the power required to drive the dynamo being 116 hp., of which 44 per cent. was lost in the dynamo and motor, and 11 per cent. in the 70 miles of the outward and return wire. There is no reason however why much more efficient results should not have been obtained; as much as 18 per cent. of the total power was absorbed for maintaining the magnetism of the field of the dynamo, whereas in a well-designed machine less than 5 per cent. should suffice. Mr. C. E. H. Brown, of Oerlikon, has succeeded in transmitting by electricity 50 horse-power from water power at Kriegstetten over a distance of 5 miles to Solothurn in Switzerland, with a commercial return of over 70 per cent.

At Hatfield, on the Marquis of Salisbury's estate, the River Lea is utilised to generate electricity, which is transmitted to the house and over the estate for a variety of purposes. Two turbines are used: one to drive a 40-h.p. Siemens alternating-current dynamo, for lighting the house; and the other to drive a 16-h.p. Brush machine, for arc-lighting at night, and in the day for working the motors at the house and on the farm. Those at the house drive pumping and ice-making machinery, and a 24 in. Blackman air-propeller fixed in the roof for ventilating; on the farm the motors are used for elevating hay and corn sheaves to the tops of the stacks, for thrashing, for cutting rough grass with a chaff-cutting machine for ensilage, in fields extending to a distance of two miles, for grinding corn, etc., to make fodder, and for other purposes. The motors have also been used for pile driving, for making cofferdams where necessary in the river; and also for dredging the river and clearing it of weeds. A Gramme motor, capable of raising 2,500 to 3,000 gallons per hour, pumps the town sewage into a tank at a height of 30 ft. for irrigation. The conductors are carried overhead on poles about the farm, and underground in wooden troughs to the house.

The practical methods of accomplishing electric locomotion seem to the author to be the four following:—

Firstly, the use of a third insulated rail or conductor to convey the current from the generator to the motor carried on the locomotive, contact being made by a wheel or a sliding spring or brush; while the two ordinary rails serve as a return circuit, the current being conducted from the motor to the rails through the frame, axle, and wheels of the locomotive.

Secondly, the employment of an overhead conductor supported on poles or from the roof of an arch or tunnel, contact being made either by a carrier on wheels running along the conductor, or by rubbing. The return circuit may be either through a second overhead conductor, or through the ordinary rails as in the third-rail plan.

Thirdly, the use of an underground insulated conductor, placed in a conduit between the rails, and conducting the current from the generator through a contact carriage to the motor, whence it is conveyed back through the frame, axles, wheels, and rails.

Fourthly, the employment of storage batteries, placed preferably under the seats of the car, with the motor and gear underneath, or the whole placed on a separate locomotive.

The plan of using the ordinary rails as positive and negative conductors, and insulating the wheels or axles of the cars, is attended with the objection that, owing to the rail supports having to carry heavy loads, there is difficulty in insulating the rails sufficiently to prevent excessive leakage to earth.

Of these four methods the first two are the cheapest and most efficient, but are applicable only to railroads: while the two other plans, of an underground insulated conductor, and of storage cells on the car, are both applicable to street tramways.

The plan of transporting material in skips on overhead wire-ropes by means of electricity, introduced under the name of telpherage by the late Professor Fleeming Jenkin, of Edinburgh, has not so great a field for its use in this country as it may have in less populous regions, because our roads are good, and railways generally near at hand, and we have abundance of water carriage. But in places where material has to be conveyed across hilly districts

or over bad roads to the railway or water, it will be found more useful.

Of the four branches of electric engineering dealt with in this paper, electric lighting is the one which up to the present has received most attention, called forth the largest outlay of capital, and produced the most beneficial results, if not to so great extent in this as in other countries.

As regards comfort, electric lighting proves itself superior to all other methods of illumination, and its convenience has caused it to be highly appreciated, but in respect of economy, it does not as yet hold out the same decided advantages. In incandescent lighting, the cost of distribution is still heavy, though by increasing the electromotive force and the efficiency of lamps it is being much reduced. In arc lighting, the difficulty of subdividing and of reducing the amount of light given by one arc-lamp renders it expensive for general out-door street illumination, as compared with the present low prices of gas and oil. For the lighting of main streets and railway stations, or other places where a concentrated light is required, the arc-light is beyond question far cheaper than gas; and its cost per candle-power is but a very small fraction of that of gas. As the use of electric lighting extends, the cost of working becomes reduced; installations which four years ago cost fourpence per arc lamp per hour are now costing only twopence.

In the United States there is hardly a city or town of 20,000 inhabitants which has not a central station for arc or incandescent lamps; and many towns of 3,000 to 4,000 are supporting them also. On the Continent large central stations for electric lighting are already in operation in competition with gas; but there the price of gas is generally two or three times what it is in this country.

Electric Metallurgy bids fair to become speedily of the highest interest to engineers. The electro-chemical separation of ores on a commercial scale by the electric furnace has but recently been put to the test, chiefly in obtaining aluminium from corundum, its richest ore. Sir William Siemens first turned his attention to the subject, but his death occurred before he had perfected his invention. It was taken up by Messrs. Cowles, who with the assistance of Professor Mabery have devised a furnace, in which by the passage of powerful currents the refractory ore is successfully reduced. The furnace* is built of fire-brick, and lined with powdered charcoal to withstand the intense heat; it is in the form of a box, 5 feet long, 12 inches wide, and 15 inches deep. The current is conducted through the walls and into the ore by means of a number of carbon rods, 3 inches diameter, and from 2 to 3 feet long. The positive and negative carbons are introduced from opposite ends, nearly meet in the centre. The ore, mixed with charcoal and granulated copper, is put in so completely to surround and cover the carbon. The furnace thus charged is closed with a layer of charcoal and a lid lined with firebrick; without the protection of some such refractory material as charcoal the intense heat causes the firebricks to run. When the furnace is ready, the current with an electromotive force of 50 volts is turned on, and is gradually increased up to some thousands of amperes. In a few minutes the metal is melted around the electrodes and these are then moved farther apart, until the current passes through the entire charge, and the whole is in a molten condition; the corundum becomes gradually deoxidised, and the aluminium combining with the copper, while the oxygen with the carbon escapes as carbonic oxide; about five hours suffice to complete the reduction.

The process of welding by electricity, introduced by Professor Elihu Thomson, is similarly based upon the passage of a powerful current between two electrodes. In this case the two pieces of metal to be welded form the electrodes; they are brought together in close contact, and as soon as the current is sent through the joint its resistance causes intense heat until the weld is perfectly completed. The process is almost instantaneous, and the heating occurs only at the joint; tempered steel can thus be welded without in the least affecting its hardness.

Another plan of electric welding has been introduced at St. Petersburg by Dr. Bernardo, in which the heat necessary for fusion is caused by an arc. The current is conducted to the weld by means of a carbon rod, which is connected by a flexible cable with the positive terminal of a dynamo or battery, while the metal to be welded is connected with the negative terminal. The action of the arc set up by the flow of current from the carbon to the metal may be likened to that of the blowpipe flame, except that the heating is more intense and sudden, and is therefore more local. The reducing action brought to bear on the metal keeps it clean and unoxidised.

* See SCIENTIFIC NEWS, Vol. i., p. 62.—*First Series.*

SOCIETY OF ARTS.

AT the meeting held on January 25th, Lord Sudeley presiding, Mr. Walter Emden read a paper on "Theatres and Fire-proof Construction." He described the "Asphaleian" stage now in use at the Royal Opera House, Budapest, and at the Stadt Theatre at Halle, in Germany. This stage is composed of iron and masonry, the flooring only of the stage being made of wood, and all the mechanism is worked by hydraulic power.

ALDERSHOT MILITARY SOCIETY.

ON the 2nd inst., Sir Henry Halford read a paper before this Society, on the New Service Rifle, Lieutenant-General Sir A. Alison being in the chair. The author described the weapon about to be adopted, explaining its various parts, and especially the magazine, which will hold eight cartridges, is detachable, and can even be cut off from the working while attached, so that the gun can be used as a single loader. The reduction of the bore was stated to have lessened the trajectory, and so made shooting more accurate up to extreme ranges.

MANCHESTER MICROSCOPICAL SOCIETY.

AT the annual soirée held on the 28th ult., Prof. Herdman lectured upon the Life of a Sea Squirt, which was a small gelatinous mass of irregular form, having a couple of openings at its upper end, and if this little mass was touched it sent forth from one of the openings a tiny jet of water with considerable force. The lecturer described the internal structure of one of these curious little animals, and then traced the history of its life from the very beginning to the adult stage. He said that the young ascidian was highly organised, but it degenerated as it got older, and lived only for the purpose of eating and breathing.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

MEAN VELOCITY OF THE WIND.

A letter appeared in your paper of Jan. 13th on the mean velocity of the wind, in which your correspondent adduced as one reason why our weather now is windier than formerly, "the prevalence in old directions for foretelling the weather, of the rule that it will be fair if smoke ascends straight upwards, but that rain may be expected if it falls." He adds, "In *our days* smoke *very rarely* either rises or falls, but is hurried along." Now I happen to have made a number of observations for the purpose of testing the value of some of these old directions for weather prophecy which bear upon this point, as they extend over the last eighteen months. A glance at the annexed table will show the results. It is seen that there have been no less than sixty-six times when the smoke has risen or fallen more or less vertically, and this number does not exhaust every occasion, but simply those I have recorded; and many must have escaped my attention. It is, I think, a hasty conclusion to say the weather of to-day is windier than of old.

I have added to the table two other sets of observations. The red glow in the sky refers, not to the ruddy colours of sunset clouds, but to the peculiar transparent rosy hue which overspreads a clear sky soon after sundown, and lasting about fifteen minutes. The observations on gnats are perhaps too few to be of much value.

Table of Observations.

	No. of Observations.	Followed in 24 hours by	
		Fine	Rain
Red glow in sky after sunset ...	41	37	4
Gnats plentiful in the evening ...	8	5	3
Smoke ascending vertically ...	44	37	7
Smoke hanging heavily about the chimneys	22	5	17

From this table it appears there is a considerable measure of truth in some of our old sayings, but they are not infallible. The signs and the succeeding weather probably bear some relation as effects of a common cause, more or less remote, so that when one takes place there is a probability of the other happening. J. REGINALD ASHWORTH.

CATS DESTROYING FROGS.

In THE SCIENTIFIC NEWS for January 27th, I see an instance of the weasel destroying frogs. It is, perhaps, not generally known that cats have the same habit. A colony of frogs which I had introduced into my suburban garden for the purpose of keeping down vermin have been destroyed by the cats, of which there is a very troublesome superfluity. The same trespassers also destroy certain plants, especially *Nemophila pulchella* and *N. insignis*. W. S.

OCCURRENCE OF RARE MOTHS.

It may interest some of your readers to know that last season the beautiful moth *Catocala nupta* was by no means uncommon at Hornsey Rise—a locality which has now become quite urban in its character. One specimen was taken imbibing a solution of sugar which had been spread upon the trunk of a tree.

A specimen of *Deiopeia pulchella*, a species rare in the north, was found near Glasgow, in a cobweb, by a Mr. Long. The body was nearly destroyed, but the wings remain in a state which admits of clear identification. H. M.

INFLUENCE OF OCCUPATION ON HEREDITY.

Can you spare space for the airing of the following doubtless extravagant idea? Is it possible for a man's occupation, when it has been his father's or his grandfather's before him, to make itself apparent in the outlines of his face in the same way that it does admittedly influence his mental capacity? I am led to ask the question by observation of two cases strangely tending to the conclusion that occupation can have such an effect. A pork-butcher, who follows in his father's footsteps in the matter of a trade, in features has a curious affinity to the animal which it is his business to buy, kill, sell, salt, and cure, as close a resemblance, probably, as it is possible for the human face to assume. The other case is that of a man whose chief occupation in leisure moments is to superintend the rearing and education of dogs, and who is perhaps capable of no higher form of enjoyment than is to be obtained from "ratting"; and this man in face reminds one strongly of a pugnacious, ill-bred terrier.

Your readers may know of other cases where there is a similar coincidence between human occupations and facial appearances. W.

FORMATION OF HOAR-FROST.

In a recent number of the SCIENTIFIC NEWS I find it stated that though dew is most abundantly deposited in clear nights hoar-frosts are formed chiefly in cloudy weather. This is not in accordance with my experience. Not to go any further back, I find it recorded in my diary, that on January 27th and 30th of the present year there was a decided hoar-frost, whilst the morning sky was quite free from cloud or mist. CLOUD-GAZER.

AURORA BOREALIS AND MAGNETIC PERTURBATIONS.

I learn from a French correspondent that on the 26th ult. a magnetic storm raged in Paris, Bordeaux, Clermont, and Perpignan, and that in the evening an aurora borealis was observed in the north of Sweden. As these phenomena frequently accompany storms on the sun's surface, I shall be glad if any of your astronomical readers will kindly inform me whether any outbreak was noticed in the sun on that day. STUDENT.

INSTINCTIVE FEAR.

It is at least an open question whether many of the phenomena referred to by your correspondent, "Observer," in SCIENTIFIC NEWS for February 3rd, may not be rightly interpreted as cases of catalepsy, due to sudden panic. There are many instances where both human beings and animals have been rendered for a time unconscious and literally incapable of motion, the result being not their escape, but their destruction. There are, however, other cases where consciousness is retained and where the animal deliberately "shams death," watching all the time for an opportunity of escape. ALASTOR.

WILL MEN EVER FLY?

May I point out that "Avitor" appears to overlook the fact that he is insisting upon the three identical principles upon which so much stress is laid in the article in question, namely, that man is incapacitated from flying by the aid of artificial wings from want of (1) suitable bodily form, (2) suitable bodily balance (with which I suppose that your correspondent's curious phrase "plane support" is intended to be synonymous), (3) suitable steerage power. According to my reading, it is stated in so many words that man will possibly and probably eventually discover the secret of aerial transit by mechanical agency, and that what the writer of the article has endeavoured to show is that true and actual *flight* must always be to man a thing impossible by reason of the character of his bodily structure. Congratulating "Avitor" upon his ability to "construct the mechanical equivalents of natural flight," whatever that sentence may signify, I trust that his inventive friend will at an early date make known his discovery. W. T.

ANSWERS TO CORRESPONDENTS.

A STUDENT.—You can see all newly-published works of a scientific character at the Science Library, South Kensington Museum.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

STEAM CONDENSER.—A condenser has been patented by Mr. G. Best, of Benthal-road, Stoke Newington, London. The steam is passed through a perforated hollow shaft into a fan with vanes of wire gauze, or similar material. The rotating fan is open at the sides and is fitted with inclined flaps, which deflect cold air between the vanes. The condensed steam passes through an opening at the bottom, the air being forced out through a passage at the periphery of the drum.

SAFETY PIN.—A double-pronged safety pin has been patented by Mr. Oliver Goodman, of Caroline-street, Birmingham. The pin is made of wire of suitable thickness; one end of it is passed through the barrel or clasp of the hinge until an equal length projects on each side of the barrel of the hinge. The two ends are then bent so as to assume a position parallel with each other and vertical to the barrel of the hinge. The pin is of such a length that when thus bent and turned on the hinge towards the cap the ends will reach well into the cap, but will not project beyond it.

MINERS' SAFETY LAMP.—A safety lamp for mines and other purposes has been patented by James Macnab, Mortimer-street, London. The invention consists in constructing safety lamps in which water, slightly diluted with sulphuric acid to prevent evaporation of same, is employed for the purpose of preventing the flame from igniting the gas of the coal-mine and also for extinguishing the light, should the glass-holder be accidentally broken. The light, securely placed in a buoyant vessel, floats on the surface of the water, or may be fixed, so long as the vessel is in contact with the surrounding water.

GAS STOVE.—A gas stove has been patented by Mr. A. J. Boult, of 323, High Holborn, London, as a communication from J. Smith and H. J. Boyd, of Canada. A metal tube is placed over the burner, rising above and descending below it, so as to enclose the burner in or near the centre of the opening, thus causing a current of air to draw up from beneath and surround the flame, so that the whole of the carbon is rendered combustible, producing an intensely hot smokeless flame, and economising the quantity of gas consumed. The flame is delivered in this condition to a bed of lava or pumice, which acts as a spreader to the flame and attains a great heat.

SNOW PLOUGH AND GRAVEL DISTRIBUTOR.—Mr. A. Lockett, Horseferry-road, Westminster, has patented a snow plough and gravel distributor. When the machine is not required for ploughing it can be drawn over the snow on its two iron-bound edges after the fashion of a sledge. When required for use, a movable board is let down in front, which, when presented to the snow, scrapes it on one side in ridges. Two small wheels are placed behind, which travel on the road, just touching, and supply the motive power by means of two endless chains to a spindle working in a box containing the gravel at its widest end. The gravel drops on the road immediately it is scraped, through an aperture in the bottom of the machine.

IMPROVEMENTS IN GAS BURNERS.—Messrs. J. Torkington and J. Ewins of Birmingham, and C. Torkington, of King's Norton, have patented a means for economising gas. The invention consists in arranging a heating chamber in combination with the gas burner, through which chamber the gas passes, and by which it is heated on its way to the burner. The chamber is heated by the flame from the burner. The gas is thus caused to expand before issuing from the burner which together with its being heated before ignition causes it to be more effectually consumed and prevents smoke being formed.

APPARATUS FOR CHLORINATING ORES.—Messrs. Bough and Hinksman, of Bloomsbury, London, have patented an apparatus for chlorinating ores. The furnace used is constructed with arches separated by narrow spaces over which columns of pyrites in lumps are built, the intervening spaces being filled with a mixture of ore and salt. A fire is started beneath the arches, and when the pyrites have ignited they complete the process; the metals are obtained as chlorides. If it be found that all the gold has not been converted, free chlorine may be passed through after removal to the lixiviating tanks.

REGENERATIVE GAS LAMP.—Mr. T. G. Marsh has patented a regenerative gas lamp. In this invention the gas is caused to issue laterally from holes round the gas supply pipe. Immediately below these holes is placed a flange having a diameter of about double the gas supply pipe, so that the issuing gas passes over it. The nozzle of the central air supply pipe, which is about double the diameter of the flange, is preferably placed about one-eighth of an inch above and around the flange. When the gas is burning, the incoming air from the central supply pipe causing the issuing flame to be slightly compressed against the flange, very materially increases the brilliancy of the remaining portion of the flame, the interior of which is supplied with air from the central supply pipe, and the exterior by a suitable quantity of air admitted into the globe.

FOLDING HOODS FOR VEHICLES.—An improvement in the folding hoods of barouches and other vehicles has been patented by Messrs. J. Clinch and J. Coleridge, of Manchester. Instead of connecting the extremity of the "joint" at each outer side of the hood to a stud affixed to the body of the vehicle, the extremities of each "joint" are connected to the opposite ends of a metal rod mounted in suitable bearings across the back of the vehicle. Branching from this rod is an arm, the end of which is fitted with a nut, through which passes one end of a screwed spindle, the other end of which is guided through an eye rising from the elbow. This arrangement permits of a coil spring being mounted upon the screwed spindle, and the compression of which can be adjusted by turning the screwed spindle through its nut. An actuating lever arm also branches from the same rod. To raise the hood it is only necessary to raise the front stick, but without touching the "joints" at either side, the striking of these "joints" being effected by the operation of the coiled springs. To lower the hood it is only requisite to press down the actuating lever until the "joints" strike in the opposite direction, when they fold together, closing the hood at the same time.

TECHNICAL EDUCATION NOTES.

AGRICULTURE.—Professor Wallace, of Edinburgh University, has issued a proposal for the development of agricultural education in Scotland. He urges the increasing of educational institutions rather than the establishment of experimental farms.

CARPENTRY EXHIBITION.—The Carpenters' Company and the Joiners' Company propose jointly to hold an exhibition of models, drawings, and specimens of works in wood, within the respective trades designated by their titles, at Carpenters' Hall in May and June next. The first division consists of constructive carpentry, in which skill in obtaining the greatest amount of strength at the smallest expenditure of material and labour is the object aimed at. The various classes include roofs, bridges, floors, beams, centring, scaffolding, etc. The second division is that of ornamental and constructive carpentry, in which architectural or picturesque effect, combined with strength and efficiency, is the aim. The other divisions are joinery and wood-carving, all in hand work.

TRADE SCHOOLS AND TECHNICAL SCHOOLS.—Professor Garnett, writing in the *Contemporary Review* for November last, points out a distinction between trade schools and technical schools which deserves to be kept steadily in view. He says:—"In a trade school students learn precisely what they would in a workshop. The technical school is intended not to take the place of the workshop, but to supplement its teachings. In the workshop the apprentice is taught to imitate; in the technical school he should be taught to think. In the workshop he performs the same operation repeatedly and under the same conditions until he acquires manual dexterity. In the technical school, if he repeat an operation, he varies the conditions so as to acquire practical knowledge and be prepared for any emergency that may arise."

THE TELEGRAPHISTS' SCHOOL OF SCIENCE.—We learn from the *Electrical Review* that this school, which was established twelve years ago by Mr. W. Slingo, at the Central Telegraph Office, is in a very satisfactory condition, and is doing excellent work. The practical laboratory and workshop classes have been well attended. The workshop, being available at all times, allows students to make profitable use of the odd hours intervening between the expiration of official duties and the beginning of the lectures. The course of instruction is:—Monday, 6 to 8 p.m., workshop practice; 8 to 9 p.m., magnetism and electricity; 9 to 10 p.m., technical telegraphy. Wednesday, 6 to 7 p.m., magnetism and electricity; 7 to 8 p.m., technical telegraphy; 8 to 9 p.m., advanced electricity and laboratory practice. Friday, 6 to 8 p.m., workshop practice; 6 to 7 p.m., elementary laboratory practice; 7 to 8 p.m., advanced mathematics; 7 to 9 p.m., elementary mathematics.

ANNOUNCEMENTS.

GEOGRAPHICAL SOCIETY OF FRANCE.—The celebration of the La Perouse Centenary has been postponed till the 28th of April.

THE MELBOURNE EXHIBITION.—In view of the importance attached to the representation of Lancashire industries it has been resolved to erect a special building for their accommodation, covering a space of 100,000 square feet.

MINING ASSOCIATION AND INSTITUTE OF CORNWALL.—In connection with this institution it is proposed to establish a museum of mineralogy, of a purely practical and educational character, to illustrate the geological structure of the important mining districts of Cornwall.

BRISTOL ENGINEERING SOCIETY.—At a recent meeting of the Engineering Society, the officers for the ensuing term were elected as follows:—President, Professor Ryan, M.A., D. Sc. M. Inst. M.E.; Hon. Vice-President, D. C. Selman; Vice-President, John P. Littleton; Secretary and Treasurer, A. J. Ward; Librarian, C. P. Banham; Committee, Messrs. Dix, Fonseca, Pinto, Ames, Shepherd, and Bruce.

SOCIETY OF ENGINEERS.—The first ordinary meeting of the Society of Engineers in the present year, was held on Monday evening, February 6th. The "Bessemer Premium" was given to Mr. Edmund Olander for his Paper on "Bridge Floors"; the "President's Premium" to Mr. R. M. Bancroft for his Paper on the "Renewal of King's Cross Roof;" a Society's Premium was also presented to Mr. E. C. Thrupp for his Paper on "A new Formula for the Flow of Water;" and a Premium awarded to Mr. R. J. Hutton for his Paper on the "Stability of Chimney Shafts."

NETLEY ARMY MEDICAL SCHOOL.—The fifty-fifth session of this school was brought to a close on the 2nd inst., when Mr. G. D. Pollock, of St. George's Hospital, distributed the prizes. All the students for the Indian service gained commissions. Mr. A. E. Roberts gained the Martin Memorial Gold Medal and the prize in clinical medicine presented by Surgeon-General W. C. Maclean, C.B. Mr. D. M. Davidson gained the Herbert Prize of £20, the Montefiore Medal and Prize of 20 guineas, with the Parkes Memorial Bronze Medal. Mr. J. Holt gained the prize in pathology presented by Sir Thomas Crawford, K.C.B., and Mr. T. B. Maynard gained the Montefiore second prize.

PARIS EXHIBITION, 1889.—The French Minister of Commerce and Industry has appointed a committee to preside over Section I. of Technological History. M. de Rozière is the President of the Committee, and M. P. Topinard, editor of the *Revue d'Anthropologie*, the Acting Secretary. This section will deal with physical or technical anthropology, prehistoric archæology, and ethnography; four other sections will represent the liberal arts, arts and trades, means of transport, and military science. The home of this department will be in the Palais des Arts Libéraux. The secretary of the first section appeals to anthropologists for contributions to illustrate racial types.

GEOLOGISTS' ASSOCIATION.—At the annual general meeting, held on the 3rd inst., the election of officers resulted in the following being appointed:—President, Mr. F. W. Rudler; Vice-Presidents, The Rev. Professor T. G. Bonney, Dr. Hicks, Professor F. Meldola, and Mr. W. Topley; Treasurer, Mr. J. Hopkinson; Secretaries, Mr. J. Foulerton and Mr. B. B. Woodward; Editor, Professor G. J. Boulger; Librarian, Mr. J. Bradford; Members of Council, the Rev. E. S. Dewick, Mr. H. H. French, Mr. W. B. Gibbs, Mr. T. V. Holmes, Mr. W. H. Hudleston, Mr. J. L. Lobley, Mr. J. Love, Colonel C. H. M'Mahon, Mr. S. H. Needham, Mr. E. T. Newton, Mr. T. J. H. Teall, and Mr. A. S. Woodward.

RESEARCHES IN NATURAL HISTORY.—The Committee of Schnyder of Wartensee's Foundation, Zürich, have decided to offer for the year 1890, a prize for a research on the following subjects: "New investigations regarding the relation which the formation of the bones bears to the statics and mechanics of the vertebrate skeleton. The results of the investigations as a whole to be demonstrated in detail, by way of example, on the skeleton of a definite species." The conditions are as follows: Competitors for the prize must send in their work in German, French, or English, by September 30, 1890, at the latest, to the following address: An das Präsidium des Conventes der Stadtbibliothek in Zürich (betreffend Preisaufgabe der Stiftung von Schnyder von Wartensee fur 1890)." The award will be made by a Committee consisting of the following gentlemen: Prof. Hermann von Meyer, Zürich; Prof. L. Rutimeyer, Basle; Prof. H. Strasser, Berne; Prof. Otto Mohr, Dresden; and Prof. Albert Heim, of Zürich, representing the Committee offering the prize, who are authorised to award a first prize of two thousand francs. A further sum of one thousand francs is placed at their disposal for distribution in minor prizes according to their discretion. The work awarded the first prize to be the property of the Foundation of Schnyder of Wartensee. Each competing work must bear on the title page a distinguishing motto, and must be accompanied by a sealed envelope containing the name of the author, and bearing on the outside the same motto.

DIARY FOR NEXT WEEK.

Monday, *Feb.* 20.—Society of Chemical Industry, at 8 p.m.—*The Bromine Absorption of Mineral Oils*; Mr. James B. McArthur. *Notes on Camphor Oil and Oil of Sunflower*; Mr. C. T. Kingzett.

Falmouth Literary and Scientific Society.—*Sun Spots*; Rev. A. Rogers.

Victoria Institute, at 8 p.m.—*Mystical Buddhism in connection with the Yoga system of Philosophy*; Sir Monier Monier Williams.

Aristotelian Society, at 8 p.m.—*The Real Essence of Religion*; Rev. E. P. Scrymgour.

London Institution, at 5 p.m.—*Contemporary Novelists*; Rev. H. C. Shuttleworth.

Society of Arts.—Cantor Lecture, at 8 p.m.—*Yeast, its Morphology and Culture*; Mr. A. Gordon Salamon, F.I.C.

Tuesday, *Feb.* 21.—Institution of Civil Engineers, at 8 p.m.—*Manganese in its application to Metallurgy, and some Novel Properties of Iron and Manganese*; Mr A. R. Hadfield.

Royal Victoria Hall.—*Insects as Florists and Fruit-makers*; Mr. F. R. Cheshire.

Royal Institution, at 3 p.m.—*Before and After Darwin*; Professor G. J. Romanes.

Photographic Society, at 8 p.m.—*Technical Meeting.*

Wednesday, *Feb.* 22.—Society of Arts, at 8 p.m.—*The Technical Education Bill*; Mr. Swire Smith.

Royal Dublin Society, at 4 p.m.—*Ores, Earths, and Stones*; Professor W. Noel Hartley, F.R.S.

Thursday, *Feb.* 23.—Royal Society, at 4.30 p.m.

Royal Institution, at 3 p.m.—*Early Secular Choral Music*; Professor C. H. H. Parry.

Society of Telegraph Engineers and Electricians, at 8 p.m.—*On the Present State of Fire Telegraphy*; R. Von Fischer, Frevenfeld.

London Institution, at 7 p.m.—*Historical Development of Music from Bach to Liszt*; Mr. Carl Ambruster.

Friday, *Feb.* 24.—Royal Institution, at 9 p.m.—*Westminster Abbey*; The Very Rev. Dean Bradley.

Royal United Service Institution, at 3 p.m.—*How to secure our Coast-line generally against sudden attack, with the means of defence at present available, or with such means as might be made available at a few weeks' notice*; Colonel Sir Charles Nugent, K.C.B., late R.E.

Royal Dublin Society, at 4 p.m.—*Glowing Gases and Glowing Solids*; Professor W. Noel Hartley, F.R.S.

Institution of Civil Engineers.—Students' Meeting, at 7.30 p.m.—*On the Erection of the Superstructure of the Forth Bridge*; Mr. Arthur J. Knowles.

Society of Arts.—Indian Section, at 9 p.m.—*Facts regarding the religions of India and their influences on the moral progress of the people*; Sir William W. Hunter, K.C.S.I., etc.

Saturday, *Feb.* 25.—Royal Institution, at 3 p.m.—*Experimental Optics*; Lord Rayleigh.

Physical Society, at 3 p.m.—*Note on the Efficiency of Incandescent Lamps with direct and alternate currents*; Professors W. E. Ayrton, F.R.S., and John Perry, F.R.S. *Observations on the Height and Length of Ocean Waves*; Hon. Ralph Abercrombie. *Experiments on Electrolysis*; W. W. Haldane Gee. *On the Temperature at which Nickel begins to suddenly lose its Magnetic Properties*; Herbert Tomlinson.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased; Ambers fitted.—W. GEORGE, 324, Essex-road, Islington, London.

Trouser Lengths, 5s. Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—HEWITT, 27, Winfield, Leeds.

Castings, Parts, Materials, and Finished Models.—Catalogue, 2d.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

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Opera Glasses.—Very powerful, adjustable for marine, field, or opera, in case, and sling, by celebrated makers. Cost 5 guineas; offer wanted.—P., 25, Victoria-road, Kilburn.

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Camera, 8 by 5, slide and rectilinear lens, first class. Accept 110s.—EDWARD HUGHES, Graigue, Kilkenny.

Magic Lantern.—Double lantern, nearly new, 4in. condensers, and all the newest fittings, stand, sheet, etc.; also magnificent lot of slides, can be used for oil or limelight, all complete, a bargain. Can be seen at any time.—R. B. S., 46, High-street, Nottinghill, W.

Crayon Sketch from any photograph (returned uninjured), 15 by 11, 1s. 2d. free.—MR. COULTHARD, Bathwick, Bath.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Mechanics' Specialities.—100 Fretwork Patterns, 1s.; 200 Turning Patterns, 1s.; 300 Stencils, 1s. List free.—COLLINS.

50 Conjuring Tricks, 1s.; 100 Experiments, 1s.; Photos, 100 Eminent Women, 1s.—COLLINS, Summerlay's Place, Bath.

How to Read Character from Handwriting, 6d.; How to Make a Lathe for few Pence, 6d.—COLLINS.

How to Learn Ventriloquism, 6d. free; Secret of Thought-reading, 6d. post free. Lists free.—COLLINS.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

Microscope wanted in exchange for large Musical Box, cost £12.—W. ASTBURY, Radcliffe, Manchester.

BOOKS RECEIVED.

The Story of Creation. By E. Clodd. London: Longmans, Green and Co. Price 6s.

Boys' Games. A Recreation Handbook for Teachers and Scholars. Edited by E. D. Bourne. London: Griffith, Farran and Co. Price 6d.

NOTICES.

The Title Page and Index to Vol. I., *First Series*, now ready, price 6d.

Binding Cases for Vol. I., *First Series*, price 2s. each.

Binding Cases and Binding, Vol. I., *First Series*, including Title Page and Index, price 3s.

Vol. I., *First Series*, bound in cloth, with Title Page and Index, 7s. 6d.—by post 8s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Prices 6d. each, or by post 7d. for the *First Series*, and 3d. each, or by post 3½d., for the *New Series*.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 8. (*New Series.*) FEBRUARY 24th, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

SCIENCE AND ART CLASSES.—Whatever shortcomings there may be in the work of the Science and Art Department, its record as a whole continues to be a very satisfactory one. From the Calendar just issued it appears that there are no less than 2,308 schools in the United Kingdom, in which Science and Art classes are held. In these schools there are 73,378 art students, and 104,821 who are being trained in science. In the science classes as many as 30,852 are learning mathematics, 20,122 inorganic chemistry, and 20,032 magnetism and electricity. From these figures it is evident that the great advance recently made in the various applications of electricity is making students realise the importance of acquiring a scientific understanding of the subject. The teaching they receive may not always be of the most practical kind—indeed, it cannot be expected that there will be suitable apparatus at all the schools—but, whatever the shortcomings, we may assume that some useful information is imparted, and we are pleased to note the large number of students ready and willing to learn. From the returns published it appears that, after mathematics, the greatest number of English students enter for chemistry, machine construction, physiography, and electricity. In Scotland similar subjects are in favour, although in a different order, but in Ireland it is noteworthy that the principles of agriculture attract more attention than any other subject.

PHRENOLOGY.—The British Phrenological Association held a meeting last week, whereat a paper was read by Mr. James Webb on "The Phrenology of the Poets." Delusions die hard, but it is certainly not a little strange that any delusion connecting character and skull in such an elaborately artificial manner as does the pseudo-science of phrenology should have survived the exact scientific work of Ferrier and Munk and Schäfer on the relation between brain-structure and function. We may or may not some day see the problem wholly solved, but if we do, it will have been solved by methods akin to theirs, rather than by that of the modern followers of Gall and Spurzheim. Meanwhile the "British Phrenological Association" must make its hay though the sun is low on its horizon, and though the night is fast coming to hide "The Phrenology of the Poets" in that limbo of obscurity which already covers so many promising attempts to explain the unexplained—and even the inexplicable—by a few portable formulæ.

SCIENCE AT WOOLWICH.—A few years back *Nature* commented upon the low value set upon scientific proficiency in the Sandhurst examinations, and foretold that this would react injuriously upon those public schools which were beginning to introduce science subjects into their regular school routine. The prediction was fulfilled only too well. One public school thereupon omitted all science-teaching in the instruction given to boys who were to become candidates for Sandhurst. At Woolwich, where young men are trained for the Royal Engineers and the Artillery, science till lately met with fairer treatment, but a new code, which is to come into force in November next, unless the authorities are previously better advised, throws science quite into the shade. The marks capable of being earned are in Latin, French, and German, "compulsory" mathematics and "optional" mathematics, 3,000 each; Greek, English history, chemistry, physics, physical geography, and geology 2,000 each.

We cannot help urging that the value placed upon Latin is extravagant. "Optional" mathematics also comes off too well, for in pronouncing any subject optional we admit its secondary importance. If this scheme is brought into use we agree with *Nature* in thinking that it will not be worth while for students even of marked scientific ability to take up science. Those who do so will, other things being equal, either fail or come out lower in the list than those who rely upon their attainments in languages. Yet who can deny that for an artillery officer, and still more for an engineer, physics and chemistry are likely to be of more value than Latin? Judging from the class of minds which these regulations will select, it will soon be quite erroneous to speak of the "scientific branches of the service."

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

OUR vegetarian friends are very earnest, very enthusiastic, and have made great progress of late. In London alone, above a dozen vegetarian restaurants have been established and are flourishing. My own view of the subject is that our present practice of using the digestive and nutrient apparatus of sheep, oxen, etc., for the preparation of our food is merely a transitory barbarism that will be ultimately superseded when the chemistry of cookery is sufficiently understood and applied to enable us to prepare the constituents of the vegetable kingdom, so that they may be as easily digested as the prepared grass that we call beef and mutton. I expressed and amplified this in a chapter devoted to the subject in "The Chemistry of Cookery," but since that was published, have given further attention to the subject, and have something further to communicate respecting it, which finds an appropriate place in Table Talk as it is a table subject.

In the first place, I have learned that some who have tried total abstinence from flesh food have found themselves enjoying much better health in consequence, and that others who have tried the experiment quite as fairly have suffered considerably, displaying decided symptoms of insufficient nutrition, have lost weight, have grown pale and weak (*anæmia* is the technical name of their trouble), and have recovered on returning to a flesh diet.

What is the cause of this difference?

To answer this question philosophically and practically, we must learn what is the difference between the work that has to be done in assimilating animal food, and that demanded for the assimilation of vegetable food. That there is a difference is obvious. The conversion of bread into flesh must be a somewhat different process from the conversion of flesh into flesh.

The nature of this difference may be directly studied by comparing the digestive apparatus of the pure carnivora with that of herbivorous animals, *i.e.*, taking the *extremes*, for nobody supposes that we belong to either class.

Without going into details that would carry me beyond my limits, I may sum up the difference in general terms, as mainly consisting in the degree of insalivation. The carnivora bolt their food; some have tearing teeth, that simply cut up the flesh into fragments of swallowable size; others have no teeth properly so-called (fishes, reptiles, etc.), but swallow their prey whole, and even alive, the organs representing teeth being merely spines set backwards to prevent the struggling morsel from wriggling out of the mouth. Their salivary glands are but rudimentary.

The ruminating herbivora, on the other hand, masticate most elaborately; they first crop and slightly moisten the grass with saliva, then pass it into stomach number one, where it remains soaking in salivary secretion, then it passes to stomach number two, which forces it back into the mouth, where it is rechewed and further mixed with abundance of saliva, then it descends to stomach number three, and from thence into a stomach like our own. Even after this the food receives a further amount of what closely resembles saliva, viz., the pancreatic juice, and still further on it is continuously supplied with a similar secretion, the intestinal juice, the intestines of these creatures being very long and affording a proportionately large supply.

Graminivorous animals masticate most elaborately, with very large supplies of saliva, as shown by the froth of a horse's mouth.

We are intermediate; we do not tear raw flesh and bolt it at once in its moist and slimy state; nor do we (excepting oysters) swallow living animals whole. We do not chew the cud nor masticate oats, wheat, barley, or other whole grain, though I have heard of some extreme vegetarians trying to do this.

If we now examine the difference between animal and vegetable food and the properties of saliva we shall be able to solve the enigma.

Haller says, "*Dimidium corporis humana gluten est*," one-half of the human body is gelatine. The same is the case with the bodies of the animals we eat, gelatin being the material of which the general framework of the body is composed. Not so with vegetables; their famework is made of cellulose (vegetable fibre), and next to cellulose the most abundant constituent is starch, which has the same chemical composition as cellulose.

Both of these are insoluble in water, and neither can be digested at all until converted into something else that is soluble, that something else being dextrin (a substance closely resembling gum arabic, and commonly substituted for it) or a sugar. The conversion of starch into dextrin and sugar is the chief business of the saliva. If a purely carnivorous and *untrained* animal is forced to eat bread, nearly all the starch, which is the largest constituent of bread, passes through the animal and leaves it as starch, contributing little or nothing to its nutrition.

This conversion of the starch is effected by a constituent of the saliva and of the pancreatic and intestinal juices, to which the name of animal diastase has been given. It appears to be identical with the vegetable diastase which exists in malt, and may be extracted from it. It is formed during the germination of all seeds for the purpose of supplying food to the baby plant, which, like ourselves, can assimilate soluble dextrin or sugar, but not unaltered starch.

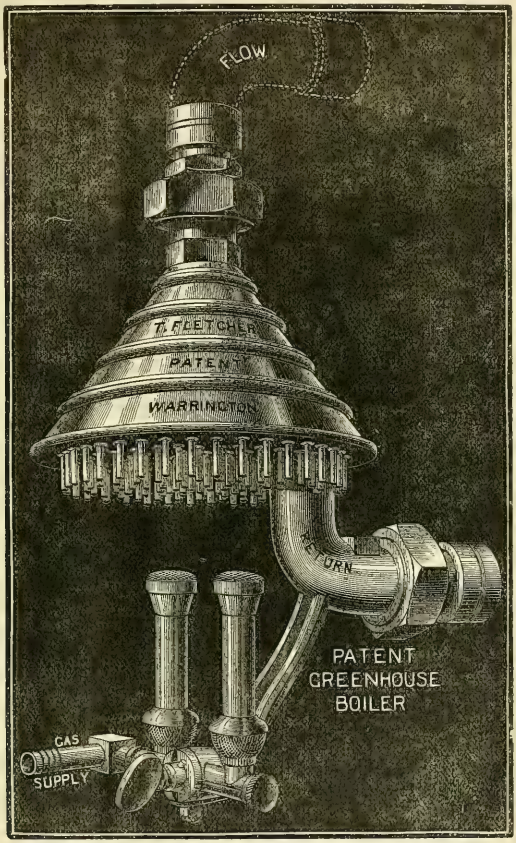
Upon these facts I build a theory, in explanation of the curious differences of the effect of vegetarian diet described above. It is that the efficiency of the salivary glands, the pancreas and the intestinal glands, varies in different individuals, that those who are well supplied with their secretions take at once to a diet mainly farinaceous, and do so with comfort and advantage, while others in whom these organs are ill-developed or sluggish in action, more or less resemble the *untrained* carnivora

alluded to above. They are starving because a certain proportion of their food passes through them without contributing to nutrition.

The reader may have observed that the adjective "untrained" is printed in italics. I have good reason for this, as it points to the "lastly," or practical application of this long sermon, which is that the organs secreting animal diastase may, like the other organs of the body, be strengthened by exercise. Dogs, and even purely carnivorous cats, may, by gradual training, become able to digest bread and biscuits. Horses, and even sheep and oxen, may be trained to eat flesh meat and enjoy it.

Among the friends of my youth was a sheep reared by a butcher, in Jermyn Street, that preferred raw mutton chops to fresh grass. Pigs, whom, as Blumenbach showed, we more nearly resemble than any other quadrupeds, may be reared upon purely vegetable diet, or, as in too many piggeries around London, upon the offal from butchers' shops, slaughter-houses, etc. They specially enjoy rats and ducklings.

Therefore, any man or woman may become a vegetarian with the aid of a little training, by passing gradually from one diet to the other, or if my theory is correct, it may be done at once with the aid of vegetable diastase, by eating malted bread which is now to be bought, or by adding extract of malt, or malt flour, to their porridge and other farinaceous food. But I must now stop, and may hereafter go into particulars on methods of such admixture.



GAS-HEATED CIRCULATING BOILER.

ORDINARY lighting gas is an expensive fuel compared with coal or coke, unless great care is taken to use it with the best appliances for recovering as much as possible of the heat produced on combustion. The economical heating of water by means of gas is especially difficult as the water contained in the vessel to be heated is necessarily at a low temperature compared with that of the gas flame, and if the latter impinges on the vessel, there is more or less incomplete combustion

in consequence of a portion of the gaseous constituents not being able to attain the temperature necessary to produce flame. Owing to this, nearly all the apparatus made for heating water by gas are unsatisfactory, and although the practical difficulties are known, it is by no means easy to find a remedy for them. In June, 1886, Mr. T. Fletcher discussed this subject in a paper he read at the Gas Institute, and he illustrated it with some interesting experiments. He showed that if water be placed in a vessel which has a perfectly flat bottom, and if this be heated over an atmospheric burner, there will be a clear space of about one-fortieth of an inch intervening between the top of the flame and the bottom of the vessel. His contention was that for the reason mentioned above, there was no actual flame contact, and in proof of this he showed that if a piece of paper were pasted on the bottom of the vessel it would not be charred or even discoloured by the gas flame playing on it. Seeing that paper is charred at a temperature of about 400° F., he argued that the gases which came in contact with the label on the bottom of the vessel were at a lower temperature than 400° F., and that, therefore, a large proportion of the heat which might be produced by combustion of the gas was lost. To meet this difficulty he fastened a considerable number of copper rods or studs to the bottom of the vessel, allowing the lower ends on the outside to be surrounded by flame and the upper ends inside the vessel to be covered with water. With this apparatus, Mr. Fletcher certainly heated a given quantity of water much more quickly, and thus reduced the consumption of gas. Since then he has improved the details of construction, and in the accompanying illustration we show a very efficient circulating boiler made on the principle above described. Various sizes are made, the smallest being only six inches in diameter and five inches high, and capable of heating forty feet run of pipe two inches diameter. The larger sizes will heat 60 and 120 feet run, respectively, of 2-inch pipe. As regards the consumption of gas the approximate allowance is one cubic foot for every 5 feet length of pipe 2 inches diameter, to maintain the temperature of the pipes at about 80° F. above that of the surrounding air.

We do not agree with Mr. Fletcher in his theory as to the paper label not being charred because there is no flame contact. It is probably true that there is no actual flame contact with the bottom of the flat vessel, but there is undoubtedly a high temperature very close to the bottom, more than enough to char the paper were it not in close contact with the copper vessel containing water. Water cannot exist in a liquid state at a higher temperature than 212° F., and it is the presence of this fluid in a metal vessel of high conducting power that alone prevents the charring of the label. Our readers will probably remember that in a previous number * we described a simple experiment for illustrating the conduction of heat, and we have merely to apply the same principle to the case of the boiler.

Without doubt the addition of the copper rods is an important step in the right direction, not only because there is a large increase in the heating surface within and without the boiler, but also because the ends of the rods furthest from the bottom of the boiler are less affected by the cooling influence of the water and can consequently become hotter, and so in turn have less cooling effect on the flame. Not only does this insure more complete combustion of the gas, but the heating effect is quicker, and with so small an apparatus as that illustrated the results obtained are somewhat remarkable.

* Vol. I., page 33.

AUTOMATIC INTERMITTENT SYPHON.

M. DELAVALLADE has invented a syphon which is capable of coming into action and stopping again, automatically, without any supervision or interference. We borrow the figures showing its construction from our contemporary, *La Nature*. Fig. 3 gives a representation of the entire apparatus as adapted to the outlet of a water reservoir. Whatever may be the irregularity of the water supply, the syphon will never act as an overflow, and it will start itself as soon as the desired level of the liquid in the tank is reached. When the tank is emptied, the syphon stops and starts again automatically a few hours later. The time of stopping, and, in consequence, the height of water remaining in the tank, are entirely under control. It is merely necessary to perforate the short leg of the syphon with a series of holes (*a*, fig 3), which are closed with wooden plugs, or opened, according to the level of water required in the tank.

The apparatus is constructed in two different forms, as shown in figs. 1 and 2. The principle of both is the same.

The bell-syphon (fig. 1) has an interior tube which is fixed in the outlet-hole, and which has at its upper end a circular tank of water, A. A movable bell, fitted with a circular partition B, covers the whole and rests upon the tube. This bell is furnished with two small external tanks R R′ connected by a tube (*t*): the lower one (R′) communicating with the interior of the bell by means of small holes.

Two bent tubes (T T′) put the tank R in communication with the two chambers (*a*, *β*) formed in the bell by the partition B. A third tube, S, issues from R, passes through the bell, and hangs vertically in the interior of the central tube fixed in the outlet-hole.

Fig. 2 represents the second form of the apparatus. It is an ordinary syphon with two turns, the other parts being similar to those just described. The part A of the curved syphon will always remain full of water like the tank A in the bell-syphon.

When the tank is empty, the syphon will be entirely without water except the part A. As the water rises gradually in the tank, so it also rises in the short leg of the syphon, in the tank R, by means of R′, and in the three tubes T T′ S. Again, as the water rises, the air is driven before it until the syphon commences to overflow.

A certain amount of pressure then exists in the chamber *a*; in the chamber *β*, on the contrary, the normal atmospheric pressure is maintained, since the long leg of the syphon is open to the air. From this instant the action of an ordinary syphon may be produced if we have the requisite conditions of flow, the air confined in the upper parts of the apparatus being swept away by the first rush of liquid.

Let us suppose that these conditions are not fulfilled. Air will then remain at the top of the syphon or of the bell and tubes T T′, and it must either be removed or

its pressure must be sufficiently reduced to produce a sudden upward movement of the column of water, and consequently the action of the syphon.

In consequence of the presence of a certain volume of

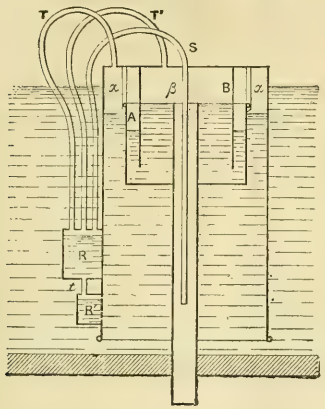


Fig. 1.

compressed air in the inner chamber a, the rate of efflux of the syphon is very low, and it increases proportionately with the external level of the liquid much less rapidly than under ordinary circumstances. Hence, whatever the supply of water, the tube S will be entirely submerged. This tube is in reality merely an auxiliary

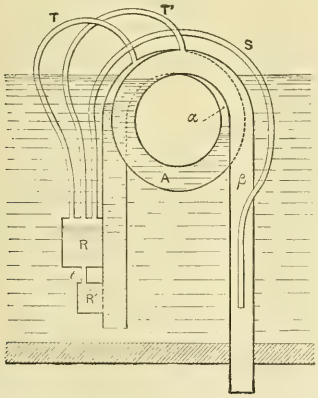


Fig. 2.

syphon, the diameter of which is so small that its automatic action is always certain; it will then almost instantly empty the reservoir R'. As this can only fill again slowly, on account of the narrowness of the tube t, there will be, to fill the vacuum thus caused, a sudden indraught of the air occupying the chambers a and β through the tubes T T restoring the equilibrium.

At this moment the jet of water issuing from the auxiliary syphon into the central tube or the main branch of the syphon causes a suction in the chamber β, and produces in a β a pressure decidedly inferior to that of the atmosphere. From this disturbance of equilibrium between the liquid and gaseous layers inside the syphon, there results a sort of small ram-stroke which causes the automatic discharge. The moment the residual air is carried away

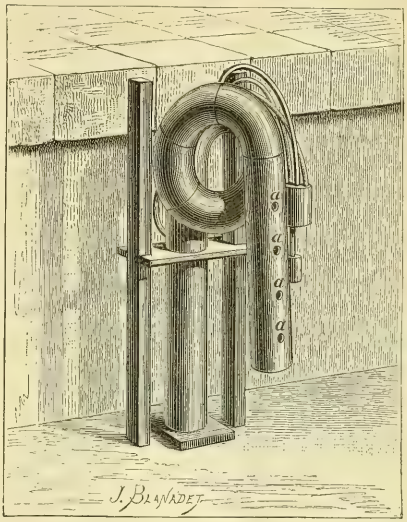


Fig. 3.

the syphon discharges a full stream with a speed depending on the height of the water in the tank.

This invention is said to be useful for expelling water from sewers, for irrigating meadows, emptying and refilling fish-ponds and removing water from quarries, etc., provided that there is a lower point of drainage.

COLOURED WORDS.

Under this strange name we wish to call attention to certain facts which have only attracted attention very recently, and which are far from being understood. The phenomena in question are certainly not physical, but seem to belong rather to the border-land between physiology and psychology. Perhaps they are connected with the mutual reactions of the senses (Scientific News, p. 126), or perhaps they depend simply upon an association of ideas.

Put in the briefest form the facts are these: There are persons, and not few, on whose minds sounds—especially musical sounds—and words are so associated with colours that the hearing of the sound suggests the colour, whilst the sight of the colour calls up the sound.

The words thus visualised are, we believe, chiefly proper names, whether of persons, places, of days or of months. For instance, Professor C. S. Minot (writing in

Science) gives an instance of a lady who associated the names of the months with certain colours; to her January, February, and March were bright yellow; April appeared blue; May, a light yellow; June, bright green; July, glaring yellow; August, orange; September, a golden brown; October, a dark brown, and November and December, grey.

The predominance of yellow and compounds of yellow is here to be noticed.

Mr. K. A. Chipman communicated to *Science* a case of three children who associated colours with the names of persons. To them Kate was red; Mary, white; Alice, violet; Dick, deep vandyke brown; and William, a watery blue.

Another person assigned to names a different set of colours. To him, Mary, was dark red; Abbie, tan; Lucy, dark blue; Richard, light grey; Atalanta, steel-grey; Charlotte, light red; Claire, light blue; Newcome, dark red; Lincoln, black; Morse, brown; Newhall, grey-black; Frank, dark green.

Dr. Nussbaümer, of Vienna, was, perhaps, the earliest observer of this class of phenomena. When a child, amusing himself by striking a fork against a glass to hear the ringing, he observed that he saw colours at the same time that he perceived the sound. So distinct was the colour-perception that if he stopped his ears, he could judge from it the loudness of the sound. He met afterwards with a medical student in Zurich who had made similar observations. To him musical notes were expressed by certain fixed colours. The high notes called up bright colours, and the low notes dull shades

M. Pedrono, an ophthalmist of Nantes, has observed the same association in one of his friends. This person had become so accustomed to the simultaneous perception of sounds and colours that he took no notice of it. But one day one of his companions, in his presence, said, speaking of a person not named, "Have you noticed his voice? It is as fine as a yellow dog"—a cant expression at that time in vogue. "Not at all," replied Pedrono's friend; "his voice is not yellow, it is pure red." The whole company laughed loudly. "What!" they said, "a red voice? What do you mean?" X then explained the curious faculty which he possessed of seeing the colour of voices. Each of the company wished to learn the colour of his own voice, and X had to satisfy their curiosity.

According to M. Pedrono, this friend of his whom we have above named X, did not seem to labour under any defect either of sight or hearing. Nor was his general health at all bad. Yet his sensitiveness to colour was so delicate that the luminous impression seemed to be made in advance of the sound impression. Before he could possibly judge of the quality and intensity of a sound, he knew whether it called up in his mind a red, a blue, a yellow, or some other colour. Unlike the student of Zurich, he did not find a change of colour accompanying every modification of tone. A sharp note merely seemed to him brighter, and a flat one duller than the corresponding natural note. But the same piece played upon different instruments produced various sensations. The Breton air, "Au Hallaika," if played on a tenor saxophone or a harmonium, was yellow; on the clarionet it was red; a blue on the piano.

A certain Dr. Z., studied by Signor Ugheth, gave some precise observations which were published in *La Natura* in 1884. To him the sound of the flute was always red, ranging from a dark red in the lower notes to a light red in the upper. Yellow predominated in the sounds of the clarionet; the guitar and the trumpet were golden yellow, and the piano white.

We find colour sensations produced in some persons by single letters, chiefly by the vowels. According to Pedrono's friend, the vowels *i* and *e* (pronounced as in Italian and Spanish) are attended by brilliant colours; *ou* by dark colours, and *a* and *o* by intermediate shades. To another person *e* seems yellow, *a* dark blue, *o* red or orange, and *u* black. The diphthongs give secondary colours, *eu* (French) is grey, *oi* a light grey, and *ue* black. Dr. Z. connects different colours with the vowels; to him *a* is black, *e* yellow, *i* red, *o* white, and *u* coffee-coloured.

Berti's subject finds *u* not coffee-coloured, but deep blue, whilst *e* is grey instead of yellow.

Among 596 persons questioned by Bleuller and Lehmann in Germany, seventy-five answered that *a* was black, *o* white, and *i* red.

Some results published by Professor Holden, in *Science*, assign very different colours to letters, and include also consonants. To some of these observers *a* was a light straw colour, *b* a grey, *c* a tan, *d* blue, *e* and *f* both black, *g* a light straw, *i* and *j* black, *k* blue, *l* black, *m* brown, *n* dark blue, *o* light red, *p* light green, *q* blue, *r* and *s* light straw, *t* green, *u* grey, *v* yellow, *w* blue, *x* grey, *y* and *z* dark brown.

To not a few persons numbers also appear to call up colour-sensations. One such observer gives 1 as black, 2 as light cream, 3 as dark cream, 4 as brownish-red, 5 as black, 6 tan-colour, 7 greenish-black, 8 dark-straw, 9 mud-colour, 21 black and straw, 22 light cream, 23 dark straw, and 24 light brown.

Professor Holden gives another and a different set of colours for numbers, thus: 1 black, 2 cream, 3 blue, 4 brown, 5 white, 6 crimson, 7 pink, 8 white, 9 greenish, and 10 brown.

When we attempt an explanation of these phenomena we encounter crowds of difficulties. We have to ask, are the facts mere hallucinations or do they spring from accidental confusions of the auditory and visual nerve-fibres? It is established that there are motor nerve-centres adapted to specific functions; we suggest that there may be colour-centres near the sound-centres, and these different centres may affect each other. But on looking over the details of the phenomena we find little, save complications. If a physicist were asked as to a probable connection between sound and colours he would doubtless suggest that each note of the gamut would correspond to some one spectral colour, whilst noise, as distinct from sound, would call up browns, olives, drabs, and other impure colours. But no such regularity can be traced. Moreover the connection of colours with arithmetical figures, which are apprehended not by the ear but the eye, remains totally unexplained.

A NEW LACQUER.—Under the name of ardenbrite, a new lacquer has recently been introduced by the Ardenbrite Manufacturing Company, of 70, Southampton Row, Holborn. It is claimed that the new lacquer is so fine that it is invisible on the most delicate instruments, and so strong that it stands weather, steam, smoke, sea air, and sea water; gold, silver, copper, steel, brass, and iron are said never to tarnish when coated with it; moreover it dries hard in half an hour in or out of doors, *without heat*. We have had the ardenbrite tried by a competent authority, and the result has been quite satisfactory. We can, therefore, recommend it as being a valuable acquisition for workshop purposes.—*Electrical Review*.

General Notes.

Micro-Organisms in Hailstones.—H. Odo Bujwid, a biologist residing at Warsaw, writes to the *Annales de l'Institut Pasteur* to say that he has lately detected several species of bacilli in hailstones. In a cubic centimetre ($=\frac{3}{50}$ of a cubic inch) of water from melted hailstones he calculates the number to be 21,000.

Suffocation by Carbonic Acid.—Near Merthyr a whole family are said to have been stupefied whilst asleep in their cottage, by the carbonic acid given off from a lime-kiln close at hand. The wife and children were found in an unconscious state in their beds upstairs, but the father who had gone down into the stratum of poisonous gas lay dead on the stairs.

A Hill on its Travels.—A hill between Aegium and Patras, in Greece, on the slopes of which a railway passes, is said to have been moving towards the sea for three days, on the last of which it had advanced for about sixteen inches. The passengers of trains on the line have to alight and walk for about eighty yards, whilst the train passes slowly over this doubtful part.

Shameful Forgeries.—According to the *Popular Science Monthly*, a gang of forgers of antiquities from the Swiss "lake-dwellings" have been detected and brought to justice. They seem to have been doing a very extensive business. One of their frauds was the production of evidences of a fictitious "horn-age," which they effected by rudely carving objects of horn and planting them where they would afterwards be excavated.

Teaching Elementary Botany in Schools. — Says the Rev. Prof. G. Henslow, "The value of botany as an *educational* weapon has long been advocated, but the teacher must never lose sight of the fact, that it rests with him whether it be taught as such or merely as a matter of *instruction*. If the pupils only acquire an accumulation of disjointed facts, without having been encouraged to trace their causal relationships, it resolves itself into little more than cramming."

Exploration in New Guinea.—Captain Strachey has effected some interesting explorations in New Guinea. He finds that, when the bush along the rivers is penetrated, there is a fine, open, undulating country, perfectly healthy for Britons and Australians. He believes that the north-east corner, called by the natives Berau, is a distinct island, separated by a narrow strait connecting Geelvink Bay to the Macclure Inlet. He thinks that the native population is under a million.

Sanitary Value of Vaccination.—In Germany, the only country where not only vaccination in infancy, but revaccination about the age of adolescence, are compulsory, the mortality from small-pox per 100,000 of the population is 0·4; in Austria, 32·5; in Hungary, 242·8; in Switzerland, 21·8; in Belgium, 19·4; in England, the only country except Germany where vaccination is compulsory, but where revaccination is optional, 7·7.

The Use of Salt in Food.—Salt has been recently condemned as injurious by a Dr. Kellog, and that a vegetarian objected to it as being a "mineral" body. We should like to ask Dr. Kellogg how he accounts for the fact that all ruminants, wild and domesticated, though strict vegetarians, are greedy of salt, and will flock to salt springs, or "salt licks," as they are called in America. We should likewise beg to remind vegetarians that all plants contain mineral matter, without which they could not live. About fifty years ago a Liverpool physician contended that salt was the "forbidden fruit."

The New Chair of Evolutionism at Paris.—In an able article *La Justice* comments on the importance of the fact that the new chair of philosophical biology will be established at the Sorbonne, the institution where every progress in science was anathematised. We are reminded that the Sorbonne, even in the middle of the eighteenth century, compelled Buffon to an ignominious recantation, and that at the present day the "mitigated Jesuitism of the philosophy of Cousin" reigns there almost supreme. *La Justice* approves of the suggestion made by Professor Ray Lancaster, that M. A. Giard should be the first occupier of the new chair.

Proposed Exploration of Greenland.—Dr. Fridtjof Nansen proposes to cross Greenland, from east to west, on snow-shoes. He proposes to strike the east coast about N. lat. 66°. The distance to be traversed is about 400 miles, which it is calculated may be effected in a month; provisions for double the time will be conveyed on sledges. His objects are to confirm or disprove Nordenskiold's theory of an interior region free from ice, to make meteorological and magnetic observations, to obtain information on the mineral particles scattered over the ice (Nordenskiold's kryokonite), and to study the flora and fauna of the snow.

The Sanitary Registration of Buildings.—A conference was held on the 4th inst. at the Society of Arts, under the presidency of Sir Joseph Fayrer, to consider the above subject with special reference to the Bill which is to be promoted in Parliament during the coming season. Mr. Mark H. Judge, in the course of a paper on the proposed Bill, defined its objects as (1) to seek to protect the community against unsanitary conditions in public and semi-public buildings, and (2) to encourage attention to the sanitary state of private dwellings. Mr. Judge moved a resolution, which was seconded by Sir V. Kennett-Barrington, declaring the expediency of a compulsory inspection of all public and semi-public buildings, with a view to their being properly certified by a competent authority as fulfilling the requisite sanitary conditions, and also advocating the establishment of a public sanitary registration office.

The Elevation of Continents.—Among other proofs that the western portion of South America has experienced a great elevation in comparatively recent times, Ochsenius remarks that along the shores of Lake Titicaca are to be seen the imposing ruins of Tiohuanaco, the ancient capital of the Incas, which are fully on a par with the monuments of India and Egypt. It is impossible to believe that the highly civilized Peruvians would have erected such vast and splendid structures in regions which are now cold and inhospitable, and often ice-bound. Further, nitrate of soda is met with at Meucunga, in Atacama, at an elevation of nearly 13,000 feet, an altitude where the low temperature does not admit of nitrification. Hence, the author infers that the Andes must have been raised nearly

13,000 feet since a very recent geological epoch, and that a great part of this rise must have been effected since the existence of an advanced human civilization in South America.

THE WEATHER OF 1887.—According to *Ciel et Terre*, the past year in Belgium has been altogether exceptional in its character. One month only, July, has been warmer than the average, and another, June, has been normal, whilst all the other ten have been too cold. From July, 1885, to December last twenty-two months out of thirty have had a mean temperature below the normal range. There is no other such exceptional state of the weather on record. In 1887 the months of March and October were marked by the most intense refrigeration, and next follow January and May. Since the establishment of the Belgian Observatory, three years only, 1845, 1855, and 1879, have had a mean temperature below that of 1887. We must also advert to the unprecedented frosts of June, July, and August, experienced over a great part of the country, that of the end of September, and the intense cold of the middle of October, accompanied by unseasonable snows. In some districts not a month has been free from frost.

ANALYSIS OF METEORIC IRON.—After the violent thunderstorm which burst over London on August 17th last year, a small mass of meteoric iron, commonly known as a thunderbolt, was found in a garden at Brixton. The mass had the form of an oblate spheroid, and measured about two inches across its major diameter. The substance has been carefully analysed by Mr. J. James Morgan, analytical chemist, of Ebbw Vale, who finds it to contain the following substances:—Silica, 0·566; nickel, 1·375; iron, 40·276; sulphur, 46·053; lime, 5·478—total, 99·748. The deficiency of ·252 in the 100 parts is accounted for as being due either to experimental error, or to the presence of very minute quantities of some metal or metals which the analyst failed to discover. The results above given are the mean of a duplicate analysis, and are interesting inasmuch as Mr. Morgan is unable to find any analyses of meteoric iron of which the composition is similar to the one under notice. The only analysis that approaches it is that of an impure triolite, given by Crookes in his "Select Methods of Chemical Analysis," 1886, which contained iron, 62·38; nickel, 0·62; copper, a trace; lime, 0·08; silica, 0·56; and sulphur, 35·67—total, 99·31.

THE PROBLEM OF THE BOOMERANG.—An exhibition of boomerang throwing was recently given by a party of Australian natives at Münster before some German scientific men, who are endeavouring to discover the cause of the boomerang's curious flight. The instruments used were of two sizes, the larger being a slender crescent about 2 feet long, $2\frac{1}{4}$ inches wide, and $\frac{1}{4}$ inch thick, made of an exceptionally heavy Australian ironwood. This boomerang was jerked up into the air about a hundred yards, when it flew straight away, then turned to the left, and returned in a curved line back to the thrower, whirling around constantly and whizzing unpleasantly. One badly-directed projectile passed through a spectator's hat with a cut as clean as that of a razor. We have not heard what conclusions the German scientists have come to, or whether they have satisfactorily solved the problem; but, according to a German manufacturer, who has made some 11,000 toy boomerangs, the mystery of the movement lies in the shape, the boomerang having a sharper curvature in the middle, with unequal length of the two arms, which must be made of equal weight but of unequal thickness. The peculiarity of motion is said to be due to the difference in the length of the arms, which diverges the curve of rotation from the circular.—*Iron.*

MOVING AN HOTEL.—The ownership of real estate on the south shore of Coney Island, New York, is so precarious, on account of the freaks of the ocean, as to partake of the character of a lottery. A year or two ago the waves, during the winter, built up about an acre of sand at a point on West Brighton beach, precisely where the new land could be used to most advantage by the owners of contiguous property. But, as a set-off to this unexpected favour, the hungry sea has gradually eaten away the foundations of the Hotel Brighton, an immense structure, which was built on the sands, and which was doomed to swift destruction. Its owners, however, while there is yet time to save it, have determined to do so. It is to be cut up into longitudinal sections, a triple-track elevated railway built beneath each part, one hundred flat cars run under, and a dozen or more engines, coupled tandem-wise, are to be set to draw the hotel to the desired place of security from the encroachments of the ocean. This undertaking is an enterprise which will, perhaps, be best understood by the mere statement that the hotel weighs 5,000 tons, that it is three stories high, surmounted by five towers, with a frontage of 460 feet and an average width of 150 feet. The bathing pavilion, which is 475 feet long and 75 feet wide, is to be removed in a similar manner. The moral of it is that, if the Yankee mind is ever short-sighted enough to build its house upon the sand, it is also ingenious enough to devise means to rectify its mistake.—*Mechanical Progress.*

UTILISATION OF WATER POWER.—Switzerland pays Germany annually for coals a sum of about £500,000, although hundreds of thousands horse power in rivers and streams are running to waste. With the progress of electrical science, something is now being done in the direction of utilising these forces, and two projects are now under consideration. The first of these is in connection with the Goldach water works, now supplying water to the town of St. Gall. It is proposed to add a power plant to these works, and for this purpose it will be necessary to build a large reservoir, so as to obtain constant water power, which would by means of dynamos be converted on the spot into electrical energy representing 315 h.p. Of this 250 h.p. would be sent to St. Gall for lighting purposes, and 65 h.p. for working motors. The other proposal refers to the river Limmat, which is to be dammed up between Zurich and Baden by a weir, so as to obtain an available head of from 26 ft. to 28 ft. The influence of the weir would be felt for only about two and a half miles up the river. During the last ten years the minimum quantity of water passing from the lake of Zurich into the Limmat was 20 tons per second. This occurred in the exceptionally cold winter of 1879-80. At all other times the quantity was greater, but taking 20 tons as the minimum available, the promoters of this scheme estimate that 1,600 actual horse power could be obtained from turbines placed close to the weir. This power would be converted into electrical energy, and then transmitted for lighting and motor purposes.—*Industries.*

NOTES ON SOUND.

A RECENT article in the *Evening Standard* recorded with considerable detail a number of well-authenticated instances of the travelling of the sound of artillery over very great distances. The noise of the guns at Waterloo is said to have been heard by Sir Edmund Head at Hythe in Kent, at Walmer, and near Aldborough in Suffolk, the distance in the first case being no less than 110 miles. The bombardment of Antwerp in 1832 was heard on the beach at Southwold in Suffolk, and stories are told of the sound of firing having been heard over distances of 180 and even 200 miles, but some corroborative testimony seems to be needed. The frightful volcanic convulsion in the Tomboro mountain, in the island of Sumbawa, in 1815, is said to have been heard at Sumatra at the distance of 900 miles.

FIG. 1.

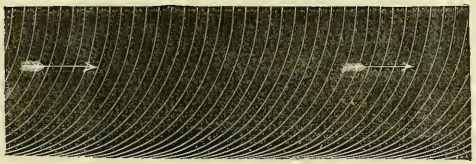


FIG. 2.

FIG. 3.

Although the propagation of sound in the air has been carefully studied, and the whole of our knowledge of the laws which govern it may be expressed by a few simple formulæ, it does not appear that any attempt has been made to find the theoretical connection between the limit of audibility and the magnitude of the disturbance which produces the sound. There is reason to suppose that a loud noise will travel rather further than a feebler one, for the following reasons: sound is the result of the transmission of a series of alternate conditions of condensation and rarefaction of the air, just as the waves on the surface of water are due to the up and down movement of the liquid, or the waves of a cornfield to the swaying of the separate ears. It is not the air which is travelling, but the conditions of pressure. Now, when air is compressed it becomes heated, and conversely, when it is rarified its temperature falls. The changes take place so rapidly that there is no time for the heat to be conducted away. Newton was not aware of this, and in attempting to calculate the velocity of sound, he found that his result was one-ninth too small, and with the readiness with which the scientific men of those days generally invented some ingenious hypothesis to assist them in such difficulties, he suggested that the molecules of air were round hard globes whose diameters were one-ninth of their distance from each other. A simple answer to this is, that air could not, in that case, be compressed to less than one-ninth of its bulk. When the effect of this heating and cooling was discovered by Laplace, it was found that the discrepancy which Newton observed was exactly accounted for. For a small amount of compression, the pressure of the air increases at the same rate as that at which its volume decreases, but for great changes this proportion ceases to be correct, and it is found that for a given diminution of volume, the pressure increases faster. Hence the mass of the air traversed by the sound will be greater in those parts than in those where the pressure is small; that is, the condensed portions will travel faster than the rarefied portions. A rather curious result follows, namely, that at certain points the condensation will have caught up the rarefaction, and the result will be silence, but at a greater distance, the sound will increase in strength, for the condensation can travel quite independently of the rarefaction.

It is often said that sound rises. Under ordinary circumstances this is not the case, for it is propagated uniformly in all directions, the waves of condensation and rarefaction being spherical, sphere within sphere, like the coats of an onion; the source of sound being at the centre. The direction of the sound is also in a straight line from the source. One reason why sounds below the observer are often remarkably distinct, as, for example to persons in a balloon, is that the earth beneath acts as a reflector extended to an immense distance all

round. There is, however, a cause which not unfrequently changes the usual straight path of a sound, and will either deflect it to the ground, or will tilt it upwards where it is lost. The former result is produced by a wind blowing in the direction in which the sound is travelling, and the latter, by an opposing wind. Fig. 1 represents the spherical waves of sound travelling uniformly in all directions from the source A, the direction being shown by the dotted lines. Now, imagine a wind to be blowing, and that a number of fine threads are floating vertically in the air. The friction of the ground will retard the wind near the surface of the earth, and the air will therefore move more slowly at low levels than at high. The threads would take the shape shown in Fig. 2. The shape of the waves of sound would be altered to that shown in Fig. 3. The direction of the sound is always at right angles to the front of the wave, as shown by the dotted lines, and if the position of the surface of the sound wave is altered from any cause, the direction of the sound will be altered also. Precisely the same thing happens with light, as was explained in SCIENTIFIC NEWS, Vol. 1, page 86 (first series). An observer at B would hear no sound, not because it has been blown away from him, but because it is tilted over his head.

The velocity of sound at freezing point is 1,090 ft. per second. It is independent of the height of the barometer, but a rise of temperature causes an increase of velocity of about one foot per second for every degree. For 51 degrees Fah., which is about the mean temperature in this country, the velocity is 1,111 ft. per second, a quantity which is very easily remembered. When the air near the ground, on a warm day, is heated by the hot soil, it is improbable that, since sound will travel faster in the hot air, the direction will be tilted upwards, and on a clear night the reverse will happen, for it is known that the temperature is sometimes 14 to 18 degrees lower on the ground than in the air, at the height of a few feet. A brisk gale will only increase the velocity of sound by about 3 per cent., and distances can often be measured with considerable accuracy by timing the interval between the flash of a gun and the sound with a stop-watch.

VOLAPÜK.

A VERY decided effort is now apparently being made to establish an international language under the above name. Probably never in human history was the want of such a convenience more experienced than at the present time. Thanks to speedy steamers and fast trains, the barriers of distance and time have been so broken down that, metaphorically speaking, the ends of the earth have become near neighbours, and as a consequence international intercourse has increased by leaps and bounds. Commerce is, of course, the mainspring of of the movement, and the want of a universal language may be described as one of the great barriers. In a country so devoted to commerce as ours, it is therefore not very surprising to find that an honest attempt to remove this particular barrier should command considerable attention. If truth must be told, we were not always so badly off for an intermediary language as at present. Two or three centuries ago Latin was the common language of intercommunication between the well-educated of all European nations. In all the universities, professorial orations and lectures were delivered in that language, so that students and professors from all countries met on common ground. Latin was also the language of the Law and the Church. Now, *tempora mutantur*, and although the study of Latin is still kept up in our schools, the great value of the language as an intermediary vehicle has long departed. It remains to be seen whether "Volapük" is destined to take its place in this particular direction. On this point we confess we are very sceptical, for although much has been done of late years in bringing about international conformity in certain matters—such as screw-threads, musical notation, telegraphic symbols, chemical formulæ, and maritime signals—these are mere bagatelles in comparison with the task of establishing a new language, to be governed by easy laws, and capable of satisfying the varied wants of diverse nations, each of whose vocabularies is constantly being increased by fresh additions. As "Volapük" seems to have really made a start, however, and its students on the continent are already said to number 500,000, the following information in connection therewith may be of interest. "Volapük" is due to the Rev. J. M. Schleyer, of Constance, who is stated to be able to speak and write twenty-eight languages, and to be more or less acquainted with an additional twenty-seven. The new language he has devised is compounded of roots, arbitrarily formed, without any necessary affinity with any existing language, though bearing more resemblance in sound and in print to the Scandinavian than to the Latin groups.

Each of the eight vowels and nineteen consonants has one fixed sound, and among the improvements claimed are brevity in spelling and in the various word inflexions, together with economy in time and increased clearness. The following are given as examples:—The word "language" is *pük;* the word *Volapük* itself means "world-language;" "I love" is *löfob;* "you love," *löfous;* "she loves," *löfof;* while the compound tense, "they will have been loved," is rendered, through the help of prefix and suffix, by *pulöfoms.* As an example of the conciseness of the new language is given the Volapük sentence of six words, "*Itisevam eibinom stabin gudikün tugas valik,*" which represents the English sentence of fourteen words, "The knowledge of one's self has always been the best foundation of all virtues." The weak point about the Volapük language seems to be the empirical nature of the words themselves; they seem so unsuggestive that, if the vocabulary becomes a large one, and we are told that the dictionaries which have been prepared for use in France and Germany already contain 14,000 words, the tax upon the memory will be very great. This strain might, to a very large extent, have been avoided, if in the case of the more common words some well-known word-root common to four or five of the chief languages had been utilised. Thus *gn* might well appear in the Volapük vocabulary for the verb "know"; for those letters, or their literal equivalents, occur in the Greek, Latin, French, English, etc., representatives of the same word; and with a little care in selection this principle might be carried out with respect to hundreds of words, to the great advantage of Volapük, not only from a mnemonic point of view, but also philologically. The English dictionary of the new language is not yet published, so that we are unable to say at present if this or any other principle is apparent in M. Schleyer's labours. We confess we view the experimental launching of this new language with much interest, and trust it will initiate the solution of what is at present a very inconvenient international problem.

Natural History.

WHALES AND THEIR USES.

It sometimes happens that a novel invention, or the discovery of some new material, deranges branches of trade which seem at first sight quite out of reach. Who, for instance, would have thought that the improvements in iron-smelting, due to Thomas and Gilchrist, would have affected the manufacture of the chemical manure known as superphosphate? Yet such is the undoubted fact. Or who could have foreseen that the progress of the so-called "ammonia" process of manufacturing alkali may possibly render the production of chloride of lime more expensive, and may thus, reversing the effect of Weldon's great invention, raise the price of every sheet of paper and every yard of white calico throughout the world?

A revolution of this kind has been brought about by the manufacture of illuminating gas and by the discovery and utilisation of ozokerite in Galicia, of paraffine wax in Scotland, and of petroleum in the United States. Before these improvements a large quantity of the oily and fatty matters used in the arts were obtained from different species of whales. Lamps in the streets, in stables, barns, outhouses, etc., were fed with train-oil, and very unpleasant was the smell. For candles, cheaper than those made from beeswax, but as clean and giving an equally brilliant light, we used spermaceti, yielded by the so-called cachalot, or sperm whale. One of these monsters has been known to furnish as much as thirty barrels of spermaceti, in addition to one hundred barrels of ordinary train-oil. Spermaceti was also used by the druggist and the perfumer in making up ointments and cosmetics.

But as regards candle-making, spermaceti is now almost entirely superseded by paraffine wax. Although salves and pomades are still sold under the name of spermaceti, they are very largely made up of mineral oils and fats, such as vaseline.

Another product furnished of the Greenland whale—the "right whale" of the fisherman—is whalebone, one large specimen yielding about a ton. But it is no longer required for the rods of umbrellas and parasols, and for the supports of ladies' corsets steel has to a great extent taken its place.

Hence the whale-fishery, which formerly employed numbers of ships and seamen from Holland, Denmark, Britain, and some of the Eastern States of the American Union, and which was at one time encouraged by especial laws, is now dwindling away. As a result the whales which were at one time so persecuted as to be on the verge of extermination are now increasing in numbers and re-appearing in seas which they had entirely forsaken. This is very similar to the condition of the beaver, which, since silk hats came into use, has little attraction for the trapper, and is now allowed to multiply in peace.

There are, however, certain products of the whale for which no substitutes have yet been found. The demand for these substances is not, however, sufficiently extensive to justify the dispatch of whalers for their sake, and the supply has become a matter of accident and the price has risen. One of these substances is ambergris, a drug much valued in perfumery, and formerly employed medicinally, and in cookery. It is sometimes found floating on the sea, but its real origin has been traced to the spermaceti whale. It seems to be a morbid product—perhaps analogous to gall stones—rather than a normal, healthy secretion. In many sperm-whales captured it is totally wanting, and is found in others only in very small quantities. Hence, though its market value is sometimes equal to that of gold, it is not worth pursuit now the other products of the whale have become so much depreciated.

Whales Caught on the Coast of Massachusetts, U.S.

There is a purpose for which a superior quality whale-oil is in demand, and for which no substitute has hitherto been discovered. We mean for the lubrication of delicate machinery, such as clocks, watches, chronometers, etc. A good lubricating oil, especially for such uses, must possess certain properties not often found in oils. It must, in the first place, contain no fatty acid in a free state, lest it corrode the metal. How readily such acids act upon brass and copper may easily be seen by examining a candlestick made of this material. If

the candle has indulged in "guttering" the cold drops of grease will be found, in the morning, coloured green by the metal dissolved.

Another essential condition is, that it must have no drying tendency. Every one knows that there are two classes of oils. The one known as drying oils greedily absorb oxygen from the air, and pass into a resinous substance. Such oils are used for mixing paints, for the preparation of varnishes, etc. The other class comprises those which are used for burning in lamps, for lubricating wheel-work, etc.

The third property is the absence of fats—stearates—capable of becoming solid at a low temperature. For this purpose the oil is exposed to an intense degree of cold, natural or artificial, when the stearine compounds separate out, leaving a liquid portion safe for use even with the most delicate machinery. The process of refining these oils is very slow, two years being necessary to submit them to all the tests required to insure the limpidity and non-drying conditions necessary to withstand the effects of changing climates which chronometers and watches are subjected to.

Our illustration represents a very extraordinary catch of "black-fish" which was effected about two years ago on the coast of Massachusetts. A large "school" of these whales was seen to approach the shore, and immediately some fishermen followed them, and succeeded in driving them into bays and creeks where the receding tide left no less than 2,200 an easy prey. These whales were bought by Mr. Nye, of New Bedford, who obtained from them some excellent lubricating "watch" oil, some of which is now being used for the famous clock of the Strasburg Cathedral.

THE MIGRATION OF BIRDS.

The naturalist who looks at the phenomena of migration from a single observing station, finds it convenient to distinguish certain common birds as summer or winter visitants, others as transient visitants, while yet others are relatively permanent. The landrail and cuckoo come to us in spring to spend the summer; the fieldfare comes in autumn to stay the winter. Some of the sandpipers flit along our shores every spring and autumn on their way to distant lands, while the rook and jackdaw are believed to stay round the year about the same elms or church-towers. Minute observation shows that the birds reputed to be permanent are not so settled as the name implies, while the class of "partial migrants," which never completely disappear, though many individuals change their quarters, is a considerable one. The song-thrush, redbreast, pied wagtail, and woodcock are examples of partial migration. In most parts of the country they may be seen in any month of the year, and yet they travel to and fro in considerable numbers, seeking food and shelter according to the season. The robins which haunt our gardens in summer are not always, or usually, the very same individuals who come to our windows for crumbs when the snow is on the ground.

Though the summer and winter visitants are so easily picked out, and though the motive of their migration seems at first sight materially different, a wider experience than is to be got in our country shows the movement is of the same kind in each case, and due to the same cause. Both summer and winter visitants move northward for breeding, and southward as the cold of winter approaches. Their ranges may differ extremely, so that the northern limit of one species approaches the southern limit of another, but this is by no means always true. The "transient migrants" come to us on their way to other countries, and stay so short a time that they are called rare birds.

It has long been known that the journeys of migrating birds are in some cases of immense length. The swallows nest in North Europe and winter in Senegal; certain cuckoos visit New Zealand every year, winging their way over the vast southern ocean; and the curlew sandpiper, which nests on the shores of the Arctic Sea, makes its way annually by India and Australia to the Cape.

Palmén has shown that the migrating birds follow defined routes, keeping to coast-lines or to great rivers. They are thus enabled to find their way more easily and to pick up a better supply of food as they travel. Palmen's chief routes are described by Professor Newton, in the new edition of the "Encyclopædia Britannica" (Art. "Birds.") The migrants form vast flocks, often consisting of several species intermixed. They rest by day, and fly by night, using the dark hours when food cannot be found, to make progress with their long journey. The cock birds are believed to arrive first in spring, starting some days or even weeks before the hens.

Wallace, and many naturalists before him, have discussed the causes of migration. Scarcity of insect-food in the winter of northern lands, and the advantage of vast, solitary wastes for rearing the young in summer, are the most obvious grounds. Since these conditions are indefinitely variable; it is probable that every gradation exists between complete coincidence of the "area of subsistence" with the "breeding-area," and complete separation.

The reports on migration of birds, published for several years past by the British Association, contain many curious facts. We learn, for example, that great flocks of rooks, grey crows, and other birds reputed to be permanent, may at times be found on the wing, passing to and fro between England and Germany. The same reports give graphic pictures of the vast numbers of birds in a migrating army, and of the density of the crowds which on a dark night dash themselves against the lantern-windows. Much has already been learnt by observations made at these numerous and well-placed stations, and whenever the results are compared and reduced, we may hope to be enlightened on many points which are now dark or uncertain.

A Rare Bird in Cumberland.—In the *Ibis* for January, the Rev. H. A. Macpherson reports that an example of the isabelline wheatear *(Saxicola isabellina)* was shot at Aigle Gill, near Allonby, on the 11th November last (1887). This bird, which is new to Western Europe, was observed by Messrs. Mann, who had a few days before been requested by Mr. Macpherson to search for doubtful wheatears. The light colour of the bird attracted their attention, and it was shot by Mr. Thomas Mann, and sent the same day to Mr. Macpherson. Mr. Seebohm, Mr. J. E. Hartine, Mr. Howard Saunders, and other experts saw the specimen, and identified it as *S. isabellina*. It was a female bird. It is worthy of remark that another species of whatear new to this country—the black-throated wheatear *(Saxicola stopazina)*—was shot near Bury, Lancashire, on the 8th May, 1875. This, as Mr. Mitchell points out in his "Birds of Lancashire," is the only example of this Southern European species which has yet occurred in Britain.

Rabbits Carnivorous. — Colonel Gordon Campbell states in the *Field* that during snowy weather, at Troup, in Aberdeenshire, scraps of meat, fish, and egg had been thrown out as food for the birds, when some rabbits made their appearance, drove away the birds, and ate up all the scraps. We believe that all rodents are partially carnivorous.

Heron Preying on Birds.—Rev. E. Elmhirst, of Shawell Rectory, writes to the *Field* that a heron in captivity has been known to lie in wait for sparrows and martins, pierce them with his beak, dip the body in water, and swallow it at a gulp.

The Muscles of the Mollusca. — M. R. Blanchard has communicated to the Paris Academy of Sciences a memoir in which, in opposition to M. Fol, he maintains that a true transverse striation of the muscles exists in certain mollusca.

A Parasite of the African Python.—M. P. Megnin gives, in *La Nature*, an account of a tick, "harvest-bug," or *Acarus*, belonging to the genus *Ixodes*, and found upon the body of a *Python seba*. Like the rest of its tribe this vermin attaches itself to the bodies of various animals, man included, by means of the barbed hooks of its rostrum and sucks their blood. If it is pulled away the rostrum breaks off, and remains in the flesh, occasioning a troublesome sore. But if, instead, a drop of benzine or oil of turpentine is applied to the enemy it falls off dead, without occasioning any injury. It is remarkable that the female *Ixodes* attach themselves chiefly to large mammalia—buffaloes, domestic cattle, horses, etc. The males chiefly infest large reptiles and tortoises, whilst the larvæ are generally found on rodents and on lizards.

Kermese Oak.—The *Quercus coccifera*, or Kermese oak, a common plant upon the shores of the Mediterranean, has been from the most ancient times celebrated as the source of a very rich crimson dye, obtained from an insect dwelling upon the leaves, which until the discovery of the cochineal insect in America was held in high estimation, and formed an important article of commerce, but is now almost entirely unknown, even in those places where it was formerly collected.

Discovery of the Anchovy in Australia.—Mr. Saville Kent, the eminent pisciculturist and ichthyologist, has been commissioned by the Colonial Government of Victoria to examine and report on the fisheries and especially on the oyster-beds of that province. In the Gipps Land salt-lakes and at Western Port he has discovered the true anchovy in great abundance. Hence it is probable that Melbourne will be able to do a flourishing export business in anchovy sauce.

An Extraordinary Lobster.—An enormous lobster, caught near Roscoff, has been recently exhibited in the window of a fish-shop in the Rue de Sèvres, Paris. The animal measured nearly 19 inches in length, and its enormous claws were 11½ inches in length, and stout in proportion. It was considered to be very aged, if we may judge from the hairs which covered its antennæ and its legs. Its brown carapace was covered with grey concretions, and a colony of mussels had taken possession of its face, so as to blind it completely.—*La Nature.*

CHARACTERISTICS OF DEEP-SEA FISHES.

THE twenty-second volume in connection with the Challenger Expedition has just been issued. It contains Dr. Albert Günther's report on the deep-sea fishes. In his introduction to the details of the 794 specimens which were submitted to his charge for examination and description, he makes some very interesting remarks about the characteristics of these animals. Occasional specimens of deep-sea fishes have fallen into the hands of zoologists; but these could not, with the imperfect apparatus, have been taken from their proper habitat, having been captured whilst floating on the surface or near to the coast. Risso was the first (1826) to distinguish a bathybial fish-fauna, assigning to it certain fishes found in the Gulf of Genoa, and stating the depths at which they habitually live. Between 1843 and 1860, the Rev. R. T. Lowe, during his numerous and prolonged visits to the Island of Madeira, paid special attention to the wonderful variety of the fishes of the sea surrounding that island. Mr. J. Y. Johnson continued the study of the fishes of Madeira from 1862 to 1866. Their specimens were deposited in the British Museum, to which Dr. Günther, as keeper of the department of zoology, had the best access.

The materials brought home by the Challenger laid a broad and sure foundation for our knowledge of deep-sea fishes. The greatest depth from which the capture of fishes is reported was about 18,000 feet, or 3½ miles. The physical conditions under which fishes live from 600 feet up to that depth affect certain parts of their organisation. In many fishes which permanently live at 480 to 720 feet below the level of the sea, indications of their dwelling-place are observed in the black colouration of their pharynx and in the size of their eye, which is proportionally larger than that of surface fishes.

The enormous pressure which fishes at the depth of three miles require to bear is one of the primary causes affecting their organisation. At the level of the sea the pressure of the air upon the square inch is fifteen pounds, but below the surface of the sea the pressure is increased in proportion to the depth of the water. At the depth of one foot the additional pressure is seven ounces; at the depth of 100 feet, 43½ lbs.; and at the depth of 3½ miles, about 3½ tons. In many of the deep-sea fishes, therefore, the osseous or muscular systems are, as compared with the same parts of surface fishes, very feebly developed. The bones are fibrous and fissured; light with scarcely any calcareous matter, so that the point of a needle will easily pierce them. In some the primordial cartilage is persistent in a degree rarely met with in surface fishes; and when brought to the surface all the bones are most loosely connected with one another. The muscles are thin, the connective tissue is extremely loose and feeble, so that Dr. Günther experienced great difficulty in handling some to prevent them from breaking into fragments. But it is not, therefore, to be assumed that this loose connection of the osseous and muscular systems obtains whilst those fishes remain under the normal physical conditions of their abyssal abode.

Dr. Günther found that all deep-sea fishes are carnivorous, and some of them are most rapacious creatures, which must be able to execute rapid movements to catch their prey; their muscular system must, therefore, be very powerful. In coming to the surface, their body

undergoes the necessary change of freedom from enormous pressure. It is a much more extreme form of the result of light air in high balloon altitudes. In every living organism with an intestinal tract there are accumulations of free gases. Under greatly diminished pressure these gases expand; so that if the change from low depths to much higher strata be sudden, the various tissues must be distended and ruptured. What is a vigorous fish at a depth of 3,000 feet (with a pressure of half a ton on every square inch of its surface) appears at the surface as a loosely-jointed body. When, during the struggle which occasionally takes place between the fish and its prey, the fish is carried out of its regular depth into a somewhat higher stratum, the expansion of the gases will cause both to ascend towards the surface, especially if the prey-fish has an air-bladder, and the rate of speed will increase as the pressure is diminished; so that a rupture takes place in its thin skin and death ensues. One point Dr. Günther made out clearly, that abyssal life has exercised no influence on the development of an air-bladder; in none did he find an open communication between the air-bladder and the gullet.

The branches of the muciferous system are dilated to an extraordinary degree. All the cavities and canals are filled with an immense quantity of mucus, which swells by immersion in water; but its physiological use is not yet known. Dr. Günther suggests that it is to surround the fish with luminosity, the more so as the mucus has been actually observed to have phosphorescent properties in newly-caught specimens.

The so-called phosphorescent organs have been noticed ever since the first species was described; but they were regarded as peculiar piquant spots or modified portions of the scales. Cocco (1838) first asserted that the pair of whitish gland-like bodies on the upper side of the snout have phosphorescent properties; but Ussow (1879) declares them to be accessory eyes. Leydig (1881) holds the opinion that they are "pseudo-electric" organs, which emit light; but Emery (1884) adopts the view of their phosphorescent nature.

During Dr. Günther's examination of the Challenger fishes he found the luminous organs widely distributed over the various organs of the body, but not equally so among the various families. When, however, the muciferous system is most developed, the luminous organs are almost entirely absent—that is a remarkable fact. These organs present many modifications as regards their seat, appearance and structure. In their most primitive condition they appear as innumerable minute tubercles more or less raised above the surface of the skin, and covering the sides of the body; they are crowded together in transverse bands, corresponding to the segments of the muscular system. More differentiated are the eye-like spots, of a white colour in preserved specimens, and red or green during life in several specimens. In others, still more differentiated, are large round flat organs of a peculiar mother-of-pearl brightness, arranged in rows on the lower side of the body and head.

Light-producing organs are very generally distributed in the deep-sea fishes, and those parts of the depths of the sea in which phosphorescent animals are abundant must be sufficiently illuminated to enable such of them as are provided with well-developed eyes to perceive objects with as much distinctness as do the forms which sport at the surface at night, and are dependent on the light of the moon and stars and the general phosphorescent light around them. There is no doubt that fishes contribute a considerable amount of this luminosity of the abyssal depths.

This light may be produced by the luminous organ to enable its possessor to see. It proceeds from the general surface when the fish is active, and ceases when it is at rest. In those fishes in which the organs are very highly developed, the production of light seems to be subject to the will of the animals. If the light were constant, or if it were not under the control of the fish, then it would be a beacon to scare its prey, rather than a help to secure it. The attacking fish seems to be able to shoot rays of light in the direction which it wishes to explore for the purpose of discovering or following up its prey. Dr. Günther compares them to a constable's "bull's-eye" lantern, which can be opened or shut at his will.

The luminous organs which are placed on fin-rays or tentacles are for attracting smaller fishes. It is well-known (as in salmon spearing) that aquatic animals are in the dark attracted by a light; and therefore these luminous appendages prove most efficient lures in the abyssal darkness, to attract prey for the rapacious assailant. The comparatively rare occurrence of special organs of touch in deep-sea fishes, show that the majority depend on the sense of sight for the perception of surrounding objects, and that therefore a large amount of light must be distributed, at least locally, in depths to which the surface light does not penetrate.

The gill-laminæ appear short and shrunken, and reduced in number; nor do they possess the same extent of respiratory surface, so that the intensity of the breathing process seems to be more diminished than in surface fishes. Doubtless dwelling at such a depth must have some effect upon circulation, respiration, assimilation of food and secretion; but Dr. Günther does not hazard a conjecture as to the manner and degree in which these functions may differ from those of surface fishes.

It is curious to notice that the spawn of some deep-sea fishes is developed at the surface, whilst mature individuals reside at more or less considerable depths. Dr. Günther does not think that these fishes rise to the surface at the season of propagation; but he is of opinion that the spawn is deposited at a depth of several thousand feet, and gradually rises to the surface. The young fry, after a short sportive life near the surface, with patriotic sympathies return to the depths of their progenitors. In the case of others, the spawn remains at the bottom of the sea throughout the period of its development. But there is a marked difference between the two kinds of fishes; the one developed under the accelerating influences of light, warmth, and oxygen, supplies the deep sea with the forms which retain the organisation of the surface fishes; the other slowly developed under the retarding conditions of darkness, cold, and deficient oxygen, supplies those degraded forms which otherwise cannot be accounted for.

Dr. Günther reports that the colours of deep-sea fishes are extremely simple, their bodies being either black, pink, or silvery; some are of a bluish colour; in a few are some fin-rays of a bright scarlet hue; but black spots on the fins or dark cross-bars on the body are of very rare occurrence. The body-cavities are generally coloured black. The highly specialised luminous organs on the head of some species are green or pink during life, whilst they fade into white after the immersion of the fishes in preserving spirit. Among the black-coloured deep-sea fishes, albinos are not scarce.

Reviews.

Proceedings of the Philosophical Society of Glasgow. 1886-87. Vol. xviii. Glasgow: J. Smith and Son.

This volume contains no fewer than thirty-four memoirs, many of which are of very decided value. Some of the papers here inserted lie, however, completely outside our competence. As such we may mention Mr. Charles Gairdner's address, inaugurating the Economical Section, and that by Mr. A. Ferguson, entitled, "Some Minor Rights of Land-ownership." The former of these papers, and, indeed, the establishment of the Economical Section, seems to us not unlikely to open a sideway for the introduction of politics, than which nothing is more strongly to be deprecated.

Mr. Adolf Schulze gives us an account of the new apochromatic objectives and compensating eye-pieces made by Zeiss, of Jena. We learn that the Prussian Government, from a conviction of the value of the researches of Zeiss, Prof. Abbe, and Schott has granted them a subsidy of £3,000 for carrying on their experiments on a practical scale. The new objectives are more purely achromatic than any previously constructed. Mr. Schulze considers that we have now as good as reached the limits of microscopic vision, and that no further important improvement is possible until suitable media of far higher refractive power have been discovered. A short time ago there was a rumour of such a kind of glass having been invented in Sweden, surpassing the diamond in refractive power. We fear the news is too good to be true.

Mr. W. Milne, B.Sc., read a memoir on *Stylostoma Forrestii*, a new tentacaliferous protozöon and other infusoria.

The Rev. James Chalmers discourses on the manners and customs of some of the "Tribes of New Guinea." Their superstitions seem to be many and strange. They live in abject dread of the sorcerers, and cannot understand how it is that the arts of these impostors have no effect upon white men.

In a paper by Mr. D. Sandeman on "Technical Education" we notice the gratifying fact that "not long since the designs for nearly all the lace fabricated in Nottingham came from Paris, but now the large majority of the designs used in England were the results of work done in the Nottingham Art School." The injurious effects of the system of "payment by results" (so-called) are frankly admitted, but it is curiously stated that the remedy "must come from the manufacturers rather than from the State." But should not the State abandon the system at once?

Mr. W. Key, in his memoir on "Coal Gas," shows that when such gas is manufactured above 18 or 20 candle power the deterioration from exposure to frost is increased. "The endeavour to maintain the Glasgow gas at 26 candle power in midwinter costs at each manufacturing station a sum of from £50 to £80 daily for extra quantity of first-rate coal."

A most important paper here to be found is that of Prof. E. Thorpe, F.R.S., on "Certain Modern Developments of Graham's Ideas on the Constitution of Matter." He points out how the late Angus Smith "had indicated in precise and luminous language Graham's position in that chain of thinkers which includes Leucippus, Lucretius, Newton, and Dalton. Like Leucippus he held the essential oneness of matter. His work centralises round the fundamental conception of atomic motion. He conceives that the various kinds of matter, now recognised as different elementary substances, may possess one and the same ultimate molecule existing in different conditions of movement. The author refers to the masterly exposition of these views in the address delivered by Mr. Crookes before the chemical section of the British Association at its Birmingham meeting. This savant applies to the question of the genesis of the elements the same principle of evolution which Laplace had already applied to the creation of the heavenly bodies, and which Lamarck and Darwin had applied to the origin of the organic world. All appeal to the law of continuity. All hold that nature is one harmonious whole. All reject the view that stars, elements, animals, and plants have either originated by chance or have been primordially created.

Mr. A. Kay contributes a paper on "The Aboriginal Australian, as He was." But was he aboriginal? Mr. Kay, after considering the differences between the extinct Tasmanian and the "black fellow" of the Australian mainland, suggests that the latter may have been intruders. But the difficulty is to trace out their origin. The writer considers that before many generations pass the Australian blacks will have been improved off the face of the earth.

Dr. Duncan writes on the "Reform of our Present Methods of Disposal of the Dead: Earth-to-Earth Burial *versus* Cremation":—"All our readers may not be aware that 'earth-to-earth burial' differs from ordinary interment merely in the comparatively unimportant point that the corpse is enclosed not in a compact, air-tight coffin, but in a porous receptacle. That this arrangement will expedite decomposition is indisputable, but that putrefaction under such circumstances will assume a different and harmless character is an exceedingly bold statement. It is to be lamented that the supporters of this scheme should rank among the bitterest opponents of cremation, which Dr. Duncan shows is the only satisfactory method of disposing of the dead."

An obituary notice of the late Robert Gray deserves mention. This gentleman, an enthusiastic ornithologist, was to a great extent instrumental in securing a legal "close time," both for land birds and sea-fowl. As a reward for his labours in the cause of science and humanity, he was forbidden by the proprietor to set foot again upon Ailsa Craig.

We may mention that Mr. Gray's "Birds of the West of Scotland," published at 7s. 6d., now commands from 40s. to 50s. per copy. His work on the birds of East Scotland was practically complete at the time of his death, and it will shortly be published by his friend, Mr. Evans. His widow and his children are understood to be working out the palæontology of Girvan.

An Easy Guide to the Constellations, with a Miniature Atlas of the Stars, and Key Maps. By the Rev. James Gall. London and Edinburgh: Gall and Inglis. Price 1s.

Starting with the well-known constellation of the Plough the author of this little pamphlet points out in succession the constellations visible in the northern hemisphere, giving a brief description of each and the way to find them. The work is well illustrated with nineteen diagrams and six charts, and key maps. The best feature in this book is that the author, instead of representing the magnitudes of the stars in the usual conventional way, has adopted a method which approxi-

mates more closely to their apparent brilliancy, thus rendering it easier to identify the stars depicted on the diagrams. With the aid of this excellent and cheap little work, teachers in public elementary schools should be able to give their pupils enough instruction to enable them to take an intelligent interest in the appearance of the heavens.

The Constellations and How to Find them. A Popular and Simple Guide to a Knowledge of the Starry Heavens. By William Peck, F.R.A.S. London and Edinburgh: Gall and Inglis. Fourth Edition.

This work is illustrated with thirteen maps, showing the position of the constellations in the sky during each month of any year, with a separate description of each map, and the fact that this work has reached its fourth edition shews that it is evidently appreciated. The only fault we have to find with it is that the stars of the first magnitude are a little too strongly marked. Small figures are given in the text showing the position of the stars which have blazed out in the Crown, the Swan, and in Cassiopeia. The expected reappearance of the latter gave rise to the recent craze about the Star of Bethlehem.

Exercises in Quantitative Chemical Analysis. By W. Dittmar, LL.D., F.R.S. Glasgow: Hodge and Co., 1887.

The man who does not find himself an accurate and capable analyst after honestly working through Professor Dittmar's Exercises, may fairly conclude that he has mistaken his vocation. The drilling it gives is so thorough, the attention to practical details so minutely careful, the theory so sound, that the presumption would be almost a certainty. In addition to exercises in the analysis of inorganic and organic compounds and mixtures, there is an admirable chapter on gas analysis, in regard to which every embryo chemist has felt the difficulty of getting reliable information. The book has many illustrations of apparatus; and last, but not least, a good index. We can confidently recommend it to those of our readers who are studying quantitative chemical analysis, as likely to correct their special faults, and form in them those habits of exactness and orderliness which are essential for every good chemist.

Journal of Morphology. Edited by C. O. Whitman. Vol. I., No. 1, September, 1887. Boston: Ginn and Co. London: W. P. Collins, 157, Great Portland-street.

This journal is chiefly devoted to embryological, anatomical, and histological subjects, more especially in reference to animals rather than to vegetables. The first volume now before us contains articles on *Sphryænura Osleri*, on the Development of the Compound Eyes of *Crangon*, on the Germ-bands of *Lumbricus*, and on other interesting biological subjects. There is an interesting article on the Phylogenetic Arrangement of the *Sauropsida*, wherein Professor Baur, who in 1886 published evidence showing that the fossil *Stereosternum tumidum* from the carboniferous strata of Brazil, which Cope described as Batrachian, is really a reptile allied to the *Rhynchocephalia*, points out the advisability of forming a new order of reptiles which may contain *Stercosternum*. For this new order he proposes the name *Proganosauria*, and he looks upon it as the genetic source of the other reptiles.

The lithographic plates are exceptionally good, and a very fine feature in the journal.

MANUFACTURE AND COLORATION OF PRECIOUS STONES.

PRECIOUS and semi-precious stones are the subject of no little manipulation before they reach the purchaser. We do not here, of course, refer to those fraudulent imitations of jewels which are now manufactured on a considerable scale, and which not only figure in cheap rings, bracelets, and other personal decorations, but are too often palmed upon the unwary as genuine. Nor have we to discuss the partially successful attempts which have been made not to imitate, but to reproduce certain valuable jewels so as to be absolutely identical with the natural stones, not merely in appearance, but in hardness, specific gravity, chemical composition, and behaviour on exposure to air, moisture, or heat.

One of the earliest successes in this direction was achieved by M. Ebelmen, who produced artificial rubies absolutely identical with natural specimens. His process, which is too technical to admit of description here, is tedious and necessarily costly. It has not had the slightest influence upon the price of rubies, since the factitious stones, which are mostly small, cost quite as much as natural specimens of the same size. This, by the way, may not impossibly prove to be the case with gold, should its artificial production ever be found practicable—a prospect which the ancient alchemists seem entirely to have overlooked.

Artificial diamonds have also been produced. A few years ago two chemists at Glasgow took up this problem, not, however, working in concert, but employing quite different methods. Both conceived themselves successful. But the supposed "diamonds" of one of the experimentalists, on being rigidly tested by experts, proved not to be diamonds at all, but crystals of a very hard form of silica. His rival, however, produced true diamonds, though not of a large size. The process employed is not only difficult, but under possible circumstances even dangerous. Hence the inventor himself declared, in a communication to an alarmed diamond merchant, that he did not for a moment expect that his process could have any practical bearing upon the diamond trade.

But a very considerable amount of ingenuity is employed, not in either forging or reproducing precious stones, but in improving the colours of such as are obtained in the natural way. Such manipulations are applicable chiefly to stones of the second class, such as chalcedony and its numerous varieties. In its original state, chalcedony is generally white and almost transparent. But it is often found yellow, red, or green, and it is then known respectively as jasper or as chrysophrase. Other varieties are veined, clouded, or banded with several colours, so they are then known as agate, onyx, cornelian, etc. These colours, when not existent, can be produced, and when already present may be heightened and varied by artificial means. These means, it would appear, consist mainly in applying at will processes which have come into play in the laboratories of nature.

Stones of this class consist of alternating layers of material, some of which are far more porous and absorbent than others. Hence such porous layers can be saturated with any desired colouring-matter, whilst the impervious portion remain colourless or retain their original colour.

A very old method of producing black or dark-brown

layers was to steep the stones in honey or in oil, whilst they are repeatedly boiled and finally raised to a heat sufficient to char the organic matter. In consequence the honey, etc., is decomposed, and its carbon is deposited in fine particles in the pores of the stone. If any portion is more absorptive than the rest it takes a black or deep brown colour, whilst the impervious portions remain white or colourless. Such is the origin of the black and white banded onyx from which cameos are cut. Instead of applying heat, the same result is obtained more conveniently by first steeping the stones in honey and then treating them with strong sulphuric acid. Thus the honey was decomposed and its carbon was deposited in the pores of the stone just as if a strong heat had been applied.

Chalcedony may be very easily coloured blue, entirely if its texture be uniform, or in stripes if it consists of layers more or less pervious. The stones are steeped in potassium ferro-cyanide, better known by its old name of yellow prussiate of potash, and after becoming thoroughly saturated are transferred to a solution of per-nitrate of iron. Or instead, they may be steeped first in potassium ferri-cyanide (red prussiate of potash), and then placed in a solution of copperas, otherwise known as green vitriol, or ferrous sulphate.

A richer blue, more inclining to a violet, is produced by soaking the stones first in a solution of copper nitrate and then in ammonia.

The delicate green of chrysophrase may be reproduced by laying transparent chalcedony in a solution of nickel nitrate, preferably such as contains a little nitrate of cobalt. The action is slow, and takes several weeks.

Or, instead of nitrate of nickel, a nitrate of chromium may be used.

It is perfectly obvious that on similar principles chalcedony may be coloured a pink or a rose shade by steeping it in a solution of nitrate of cobalt.

The red cornelian can scarcely be said to occur as such in nature. In some districts, especially at Cambay in India, yellow chalcedonies of very good quality are found. If these are exposed to the sun for two years the hydrated ferric oxide which they naturally contain is deprived of its water, and the colour becomes a rich red. Or colourless chalcedony is steeped in a solution of nitrate of iron, and is then either exposed to the sun or to artificial heat.

It need scarcely be said that various coal-tar colours have been used for the artificial colouration of stones, but with very scanty success. It is, indeed, exceedingly easy to introduce the colours into the pores of the stone, but their want of permanence on prolonged exposure to light has proved a fatal obstacle.

The art of stone-colouring, old as it is, admits of great development, especially in its application not to personal decorations, but to the purposes of the architect.

A ONE-COLOURED RAINBOW.

AT the meeting of the Royal Society of Edinburgh on the 30th January a communication of great interest from Mr. John Aitken was read. He described a monochromatic rainbow which he had seen on Christmas Day when walking on the upper ground near Falkirk. To ordinary minds the idea of a one-coloured rainbow is paradoxical. From the time when its colours were first laid down till now we have not noticed the usual seven coloured phenomenon altered very much. Yet here Mr. Aitken assures us that he saw a red rainbow; and we are bound to accept the veracity of so accurate a physicist.

In the Eastern sky he observed a strange pillar-like cloud illumined by the setting sun; and instead of the glow being horizontal and rising from the horizon, it was vertical. Soon the illumination became more elevated; and he began to suspect that this was not a cloud at all, but the "tootle" of a rainbow. Gradually the red pillar stretched out, turned over, and became a complete arch bespanning the north-eastern heavens. He never saw anything like it before; for there was no colour in it but red. There before him was the ruddy arch, like a mysterious bow of blood, quite uniform. All the other colours were concealed by the strange red hue. After a time, on careful inspection, he observed at one or two points traces of yellow; but of the others there was not a vestige. In their place, however, he observed a dark band stretching inwards to about the usual breadth of those colours in the rainbow. The band was distinctly darker than the sky within the bow; but not greatly so. Outside of the rainbow he observed part of a secondary bow; and at several places there were traces of a supernumerary bow; the red showing itself at different places in the inner edge of the dark band.

What was the cause of this strange phenomenon of a one-coloured rainbow? Mr. Aitken took a careful look of all the scenery round and above him. The Ochil Hills, which lie to the north of where he was standing, were then covered with snow, and the setting sun illumined the snow-clad hills with rosy light. Never had he seen such a depth of colour in the fiery glow, even in the Alps; the appearance was more of a furnacy red. There was a strange coincidence in the ruddy rainbow, and the deep red colour of the snow-clad hills. Knowing that the rainbow is simply nature's spectrum analysis of the sun's light, these phenomena showed to Mr. Aitken that the sun's light was shorn of all the rays of short wave lengths on its passage through the atmosphere, only the red rays reaching the surface of the earth.

It occurred to him that every object on that afternoon ought to have appeared red, and nothing but red, if the theory were true that the red rays alone reached the earth's surface. Yet that was not the case. Everything looked to him almost the same as ordinary except for the glare of the hills and the reflection of the bow. Things were simply tinted with red, as we have seen in a brilliant afterglow. And he accounted for this by the fact that, while we only get red light direct from the sun, there was a great deal of green, blue and violet light reflected from the sky overhead; the combination of these with the red caused the light to be but little different from the ordinary. A dense curtain of clouds was overhanging the hills, and screening off the light of the sky; this prevented the other colours from combining with the red which was thus left on the snow of the Ochils and the cloud in the eastern heavens.

CAST IRON COLUMNS IN FIRES.—From experiments made recently in Berlin upon the behaviour of columns of wrought and cast iron, granite, marble, sandstone, limestone, and concrete, when subjected to the conditions which obtain in fires, it appears that cast iron stands the action of fire and water best, as it continues to support the load even when red-hot and cracked in places, whereas wrought iron gives way easily. Concrete proved to be better than marble, granite, limestone, sandstone, and ordinary brickwork. None of the natural stones resisted the fire, though granite was the best.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on Feb. 9th, 1888, a paper on "True Teeth in the young Ornithorhynchus paradoxus," by Edward B. Poulton, of Keble and Jesus Colleges, Oxford, was communicated by W. K. Parker, F.R.S. This paper was a preliminary account of typical mammalian teeth developing beneath the site of the horny plates which subserve mastication in the adult animal. In the upper jaw there are three teeth on each side; in the lower jaw two teeth, corresponding to the two posterior teeth of the upper jaw, were proved to exist, but the anterior one may be also present, for the jaws examined were not complete. The animal in which the teeth were found was about 8·3 decimetres long in the curled-up attitude in which it had been received, and the larger hairs had alone appeared above the skin.

The anterior tooth of the upper jaw was long, narrow, and simple as compared with the others; it was very fully developed, containing completely formed dentine and enamel, and its apex was nearly in contact with the lower surface of the oral epithelium. All the other teeth were broad and large, those of the upper jaw possessing two chief cusps on the inner side of the crown and three or four small cusps on the outer side, while this arrangement was reversed in the lower jaw. Dentine was only formed upon the large cusps, and was not present upon all of these. The histological details and the manner of development appear to be precisely as in the higher mammalia, a fact which strongly supports the identification of teeth with the placoid scales of Elasmobranchs. If teeth are so extremely ancient then we should expect them to be unmodified in the ancestral mammalia, although the other more recently specialised characters in the higher mammals are found in a more primitive condition in the former.

The teeth were found in some sections of the skull prepared for Dr. Parker by his son, Prof. W. Newton Parker. These sections which had not been examined by Dr. Parker were lent to the author, and Dr. Parker most generously encouraged the publication of the discovery, and assisted the investigation with other material.

GEOLOGICAL SOCIETY.

At the meeting held on January 25th, 1888, Prof. J. W. Judd, F.R.S. (President) in the Chair, the following communications were read:—

(1) "On *Ailurus anglicus*, a new Carnivore from the Red Crag." By Prof. W. Boyd Dawkins.

The specimen described is a small fragment of the right lower jaw with the last three molar teeth in position, and belongs to the Crag collection of the Yorkshire Philosophical Society. It differs in a marked degree from all fossil European Carnivores, and presents no important points of difference when compared with a series of jaws of recent *Ailurus*. The author gave a description of the fossil and comparison of it with *Ailurus fulgens*, and also a table giving the comparative measurements of the teeth and jaws of the fossil and of recent *Ailuri*. The species from the Craig was a more powerful animal than any recent *Ailuri* in the British Museum. The paper concluded with a notice of the range of *Ailurus* in space and time.

(2) "A Contribution to the Geology and Physical Geography of the Cape Colony." By Prof. A. H. Green.

The account given in this paper of the geology of Cape Colony was founded on observations made during a visit to the country of four months' duration for the purpose of reporting upon the coal.

The Bokkeveldt Beds had yielded fossils referred to Devonian. The Ecca Beds consisted of hardened sandy clays, without lamination, and often weathering in spheroids, and resembling decomposed basalt or dolerite. These beds in the Ecca pass, north-east of Grahamstown, were nearly 5,000 feet thick.

The Kimberley Shales were mainly grey and dark sandy shales, with a few thin layers of argillaceous limestone. The Karoo Beds were red and purple shales, with buff or reddish sandstone containing much decomposed felspar.

The Molteno Beds, also sandstones and shales, usually grey and dark-coloured, associated with grits and conglomerate, contained the only useful coals of the colony. These coals were peculiarly laminated, and contained much ash; the seams were destitute of sandstones, and often eroded on the upper surface.

The author reviewed the lie of the rocks and physical structure of the country, distinguishing between the area of older rocks near the coast and the later deposits commencing with the Dwyka Conglomerate of the interior. There was apparently unconformity at the base of this conglomerate; it and the overlying Ecca Beds were thrown into folds and occupied the Karoo plains, whilst the ranges to the northward were formed of the higher beds, all nearly horizontal and resting quite unconformably on the Ecca Beds. These ranges have been carved out by denudation, which had removed the Molteno, Karoo, and Stormberg Beds to the south and north.

The Bokkeveldt Beds are shown by their fossils to be marine, and possibly all the formations up to the Zuurberg Quartzite may be also marine. The Ecca Beds have yielded no fossils which would enable us to decide whether they are marine or freshwater; the Kimberley, Karoo, and Stormberg Beds are looked upon as lacustrine.

(3) "On Two New Lepidotoid Ganoids from the early Mesozoic Deposits of Orange Free State, South Africa." By A. Smith Woodward, Esq., F.G.S.

Of the two species of fishes described in the present paper, one was founded on specimens of four individuals brought to England by Dr. H. Exton in 1883, together with the types of *Trityloden* and *Rhytidosteus*, the other on two examples recently received from the same source. Both were from the Stormberg Beds of the Upper Karoo series.

After giving full details of the structure of both forms, the author showed that one species must be referred to the genus *Semionotus*, and was most nearly allied to the American types referred by Sir P. Egerton to *Ischypterus*. For this species the name of *Semionotus capensis* was proposed.

The other species agreed in its characters with the Platysomidæ, and was specially allied to the genus *Tetragonolepis*; but the nearest ally of all was a fish from the Hawkesbury Beds of Australia, *Clithrolepis granulatus*. The name of *Clithrolepis Extoni* was proposed for the new South African species.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.

At the meeting held on the 1st inst., Mr. T. B. Lightfoot read the following communication on "The Use of Ammonia as a Refrigerating Agent."

In the United States and in Germany, as well as to some extent elsewhere, ammonia has been very generally employed for refrigerating purposes during the last ten years. In this country its application has been extremely limited, and even at the present time there are but few ammonia machines successfully at work in Great Britain. Up to a comparatively recent date the only machine manufactured on a commercial scale was the original Harrison's ether machine, first produced by Siebe in the year 1857—a machine costly both to make and to work. In 1878 the desirability of supplementing our meat supply by means of the large stocks in our colonies led to the rapid development of the special class of refrigerating apparatus commonly known as the dry air refrigerator, specially designed for use on board ship, where it was considered undesirable to employ chemical refrigerants. Owing to their simplicity, and perhaps also to their novelty, these cold air machines have very frequently been applied on land, under circumstances in which the same result could have been obtained with much greater economy by the use of ammonia or some other chemical agent. Recently, however, more attention has been directed to the question of economy, and consideration is being given to the applicability of certain machines to special purposes, with the result that ammonia promises to become largely adopted.

In all cases where a liquid is employed the refrigerating action is produced by the change in physical state from the liquid to the vaporous form. It is well known that such a change can only be brought about by the acquirement of heat; and for the purpose of refrigeration that liquid is the best which has the highest heat of vaporisation. In fact, however, liquids vary, not only in the amount of heat required to vaporise them, but also in the conditions under which such change can be effected. The boiling point of anhydrous ammonia is $37\frac{1}{2}$ degs. below zero Fahr. at atmospheric pressure, and therefore for all ordinary cooling purposes its evaporation can take place at pressures considerably above that of our atmosphere.

The considerations which chiefly influence the selection of a liquid refrigerating agent are:—

1. The amount of heat required to effect the change from the liquid to the vapourous state, commonly called the latent heat of vapourisation.

2. The temperatures and pressures at which such change can be effected.

This latter attribute is of twofold importance: for, in order to avoid the renewal of the agent, it is necessary to deprive it of the heat acquired during vapourisation under such conditions as will cause it to assume the liquid form, and thus become again available for refrigeration. As this rejection of heat can only take place if the temperature of the vapour is somewhat above that of the cooling body which receives the heat, and which, for obvious reasons, is in all cases water, the liquefying pressure at the temperature of the cooling water, and the facility with which this pressure can be reached and maintained, are of great importance in the practical working of any refrigerating apparatus.

Ammonia in its anhydrous form is a liquid having at normal pressure a latent heat of vapourisation of 900, and a boiling point at the same pressure of $37\frac{1}{2}$ degs. below zero Fahr. In the use of ammonia two distinct systems are employed. So far as the mere evaporating or refrigerating part of the process is concerned, it is the same in both. The object is to evaporate the liquid anhydrous ammonia at such tension and in such quantity as will produce the required cooling effect.

The Absorption Process.—The principle employed in this process is physical, rather than mechanical. Ordinary ammonia liquor of commerce, containing about 38 per cent. by weight of pure ammonia and 62 per cent. of water, is introduced into a vessel named the generator. This vessel is heated by means of steam circulating through coils of iron piping, and a mixed vapour of ammonia and water is driven off. This mixed vapour is then passed into a second vessel, in order to be subjected to the cooling action of water; and here, owing to the difference between the boiling points of water and ammonia, fractional condensation takes place, the bulk of the water, which condenses first, being caught and run back to the generator, while the ammonia in a nearly anhydrous state is condensed and collected in the lower part of the vessel.

This process of fractional condensation is due to Rees Reece, and forms an important feature in the modern absorption machine. In the improved form of apparatus, ammonia is obtained in a nearly anhydrous condition, and in this state passes on to the refrigerator. In this vessel, which is in communication with another vessel called the absorber, containing cold water or very weak ammonia liquor, evaporation takes place, owing to the readiness with which cold water or weak liquor absorbs the ammonia, water at 59 degs. Fahr. absorbing 727 times its volume of ammonia vapour. The heat necessary to effect this vapourisation is abstracted from brine or other liquid, which is circulated through the refrigerator by means of a pump. Owing to the absorption of ammonia, the weak liquor in the absorber becomes strengthened, and it is then pumped back into the generating vessel to be again dealt with as above described.

In the refrigerator, the liquid ammonia in becoming vapourised will take up the precise quantity of heat given off during its cooling and liquefaction in the condenser, plus the amount due to the difference in heat of vapourisation, owing to the lower pressure at which the change of state takes place in the refrigerator, and less the small amount due to the difference in temperature between the vapour entering the condenser and that leaving the refrigerator, less also the amount necessary to cool the liquid ammonia to the refrigerator tempeature. When the vapour enters into solution with the weak liquor in the absorber, the heat taken up in the refrigerator is imparted to the cooling water, subject also to corrections for differences of pressure and temperature.

With regard to the amount of heat used, it will have been seen that the whole of that required to vapourise the ammonia, and whatever water vapour passes off from the generator, has to be supplied from without.

Compression Process.—In this process ammonia is used in its anhydrous form. So far as the action of the refrigerator is concerned, it is precisely the same as in the case of the absorption apparatus, but instead of the vapour being liquefied by absorption by water, it is drawn off from the refrigerator by a pump, by means of which it is compressed and delivered into the condenser

at such pressure as to cause its liquefaction at the temperature of the cooling water.

The heat rejected in the condenser is the heat of vapourisation taken up in the refrigerator, less the amount due to the higher pressure at which the change in physical state occurs, plus the heat acquired in the pump, and less the amount due to the difference between the temperature at which the vapour is liquefied in the condenser and that at which it entered the pump.

With regard to the fuel required for refrigerating by the ammonia compression process, it may be said that with an economical boiler and engine about 240,000 thermal units per hour can be eliminated by the expenditure of 100 pounds of coal per hour, with a brine temperature in the refrigerator of about 20 deg. Fahr.

The application of refrigerating apparatus may roughly be divided into the following heads :—(*a*) Ice making; (*b*) The cooling of liquids; (*c*) The cooling of stores and rooms.

Ice Making.—For this purpose two methods are employed, known as the can and cell systems respectively. In the former, moulds of tinned sheet copper, or galvanised steel of the desired size are filled with the water to be frozen, and suspended in a tank through which brine cooled to a low temperature in the refrigerator is circulated. The thickness of the blocks exercises an important influence upon the number of moulds required for a given output, as a block 9 inches thick will take four or five times as long to freeze solid as one of only 3 inches.

Ice frozen by either of the above described methods from ordinary water is more or less opaque, owing to the air liberated during the freezing process, little bubbles of which are caught in the ice as it forms, and in order to produce transparent ice it is necessary that the water should be agitated during the freezing process in such a way as to permit the air bubbles to escape. The ice which first forms on the sides of the moulds or cells is, as a rule, sufficiently transparent even without agitation. The opacity increases towards the centre, where the opposing layers join, and it is therefore more necessary to agitate towards the end of the freezing process than at the commencement. Experiments have been made from time to time with the view of producing transparent ice from distilled water, and so dispensing with agitation.

Cooling of Liquids.—In breweries, distilleries, butter factories, and other places where it is desired to have a supply of water or brine for cooling and other purposes at a comparatively low temperature, refrigerating machines may be advantageously applied. In this case the liquid is passed through the refrigerator and then utilised in any convenient manner.

Cooling of Rooms.—For this purpose the usual plan is to employ a circulation of cold brine through rows of iron piping, placed either on the ceiling, or on the walls of the room to be cooled. In this, as in the other cases where brine is used, it is employed merely as a medium for taking up heat at one place and transferring it to the ammonia in the refrigerator, the ammonia in turn completing the operation by giving up the heat to the cooling water during liquefaction in the condenser. The brine pipes cool the adjacent air, which, in consequence of its greater specific gravity, descends, being replaced by warmer air, which in turn becomes cold, and so the process goes on. Assuming the air to be sufficiently saturated, which is generally the case, some of the moisture in it is condensed and frozen on the surface of the pipes; and if the air is renewed in whole or in part from the outside, or if the contents of the chamber are wet, the deposit of ice on the pipes will in time become so thick as to necessitate its being thawed off. This is accomplished by turning a current of warm brine through the pipes.

In addition to the foregoing there are, of course, many other applications of ammonia refrigerating machines of a more or less special nature. Many of these are embraced in the second class, cold water or brine being used for the cooling of candles, the separation of paraffin, the crystallisation of salts, and for many other purposes. In the same way cold brine has been used with great success for freezing quicksand in the sinking of shafts, the excavation being carried out and the watertight tubbing or lining being put in while the material is in a solid state.

It may be added that in ammonia machines, whether on the absorption or compression systems, no copper or alloy of copper can be used in parts subjected to the action of the ammonia. Cast or wrought iron and steel may, however, be used with impunity, provided the quality is good.

IPSWICH MUSEUM LECTURES.

Dr. J. E. Taylor, in continuing his series of lectures upon "The Romance of our Common Wild Flowers," said he had already shown the wide difference existing between the popular idea of a flower and the idea of the botanist. The latter considered that any flower which possessed stamens and pistils—practically the reproductive organs—was a genuine flower. The duckweed, for instance, possessed a flower of this kind, and it was indeed one of the oldest flowering plants in the world, for the remains of it were found in the strata deposited before the Tertiary Period began. Another point upon which he had insisted was that flowering was an act of expenditure, and he had now to consider the object of certain properties in flowers. What, for instance, was the use of the perfume? It was not quite right to say that the perfumes were solely for the purpose of attracting insects. Many years ago Professor Tyndall showed that perfumes had the power of barring out the heat rays of the sun. People in Oriental countries had made the discovery long before, finding that perfumes cooled a room. In the same way the smell of a flower acted as a preservative, and this was the reason why, in a hot droughty summer, while the leaves became scorched and withered, the more delicate petals retained a delightful freshness. The halo of the perfume was a cool barrier all round and about them. Upon this point the lecturer dwelt at some length, refuting the narrow and ignorant theory that flowers were created solely for the pleasure of humanity. In the next place it was shown that, while green flowers were fertilised by the wind, which carried the pollen hither and thither, most other flowers were fertilised by organic agents—by birds, insects, and even by snails and slugs.

The reference to insects led to a digression, in which the doctor spoke of the wonderful wisdom shown by hive-bees, of the power of mimicry which some insects possessed, and of the cleverness manifested by the blue-bottle flies in dropping their eggs through the wire gauze of the safe, so that the poor cook was utterly at a loss to understand how the meat became blown. It was pointed out that the tastes of insects varied exceedingly, from the honey-loving instincts of the hive-bee to the carnivorous

tastes of the two-winged flies. Chocolate-coloured flowers with a fetid smell, like those of the japonica and the whole of the arum family, attracted the last-named insects, and the arum, so common in England, managed to hold them prisoners until the pollen was discharged from the stamens and the unwitting agents were ready to carry on the work of fertilisation.

Flowering being an act of expenditure, the next section of the lecture went to show how plants, herbaceous plants more especially, tried to save as much as possible. Some familiar but striking examples were cited in illustration. The marsh marigold, for instance, having a brilliant calyx, dispensed with petals; in the harebell, in order not to interfere with the proper uses of the rest of the flower, the calyx dwindled into a series of fine threads; in a number of other flowers some such peculiarity was noted and explained. In conclusion, the lecturer referred to the varied colours of flowers, showing that they often afforded a kind of ancestral indication of botanical genealogy, and that even in this respect there was much that might be studied with pleasure and profit.

THE INSTITUTION OF CIVIL ENGINEERS.

At the meeting held on the 24th ult., Sir Bradford Leslie read a paper on "The Erection of the 'Jubilee' Bridge carrying the East Indian Railway over the River Hooghly." The bridge carries a double line of railway over the river, which at this spot is 1,200 ft. wide and 86 ft. deep at high water spring-tides in the flood season. The bridge has a clear headway of 33 ft. 6 in. above the highest tides. Owing to the rapidity of the current, strength of the tides, and danger from the unwieldly country craft navigating the river, it was necessary to erect the bridge with very little staging in the river, and great ingenuity was shown in placing the various parts of the superstructure in position. The details are too technical for our columns.

LIVERPOOL ENGINEERING SOCIETY.

At the meeting held on the 18th ult., Mr. A. W. Brightmore read a paper entitled "Some Recent Experiments on Iron and Steel and Riveted Joints." He showed how the experiments made by Wohler and Bauschinger pointed to the conclusion that, when the nature of the stresses in the members of any structure is subject to continual reversal, the maximum load consistent with the permanency of that structure is not more than one-third of what may with perfect safety be borne when the nature and amount of the stresses remain constant. He also dwelt upon the principles that guide the design of riveted joints, and demonstrated the advantages of machine over hand riveted joints.

THE EDINBURGH GEOLOGICAL SOCIETY.

At a meeting on 19th January, a communication was read from Mr. W. Pengelly, F.R.S., on recent researches in a bone cave at Lower Brixham, Devon, called the Bench Cavern. The cave consists of a fissure, or dyke, in the limestone which gives entrance to a tunnel penetrating the hill to at least 30 feet. The floor was of stalagmite, 6 to 12 inches in thickness, resting on about 14 inches of cave red earth, lying on the limestone. The chief osseous relics found in the stalagmite were a few bones of the cave hyæna. The rarity of bones of the horse and rhinoceros was noted, as these were very common in Kent's Cavern, on the opposite side of Torbay A flint implement made from a flake was also found in the cave earth under a finely preserved jaw of a hyæna. It was 3·1 inches in length, 1·2 in breadth, and ·35 in thickness. It had no trace of polish, and there was every reason to believe it was made by a man in the palæolithic era. Mr. W. Hamilton Bell read a paper on the geognosy of the Cruachan district. In an ascent he made of Cruachan from the falls, he stated that he came upon striation on the red granite of the hill at a height of 2,500 feet. This was in a corrie, and had evidently been made by a local glacier. On the subject of the erosion of the Pass of Brander, Mr. Bell rather inclined to the belief that it had been caused by an overflow of the ice from Glen Etive, which forced its way eastward, and joined the great glacier which scooped out Loch Awe and went out by Ford to the Sound of Jura.

HALIFAX LITERARY AND PHILOSOPHICAL SOCIETY.

Professor Watson Smith, F.C.S., F.I.C., delivered a lecture on the 17th ult., on "Coal Tar: Its derivations and products." He described fully the distillation of the tar from coal, and showed that in the tar were many different liquid and solid substances, and described the method of their separation. He said that one ton of Lancashire coal, distilled in gas retorts, would produce 10,000 cubic feet of gas, 30 pounds of ammonia liquor, 12 gallons of coal tar, and 13 cwt. of coke. Among the products of the coal tar would be paraffin, benzine, naphtha, naphthaline, naphthol, creosote, pitch, anthracene, and alizarine. The light oils yielded the rich dyes, known as aniline colours. Various essences and perfumes were also produced from these oils. Soaps were scented with nitrobenzine, which few people were aware was poisonous, or they would not use it. The lecturer exhibited a long piece of flannel dyed in various shades, from colours obtained from one pound of cannel coal. A number of medical uses of tar were also enumerated, and a sample of saccharine was shown. A beautiful odour resembling heliotrope was also described and experimented with.

SOCIETY OF ARTS.

On the 27th ult., Mr. Justice Cunningham read a paper on "The Public Health in India" before the Indian section. The author proposes that an authority should be constituted in each Presidency capable of carrying out the necessary sanitary reforms.

He also urges that the Government should afford greater facilities for scientific sanitary research, and that endeavours should be made to diffuse among the populace more knowledge of the laws of health.

On the 31st ult., Mr. J. Starkie Gardner read a communication on the "Monumental Uses of Bronze" before the Applied Art Section. In this paper the author reviews the use of bronze from the earliest records to the present day.

On the 1st inst. Mr. D. F. Schloss read a paper on "The Sweating System, or the Functions of the Middlemen in Relation to Labour." This communication contains nothing of scientific interest.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE *SPECTATOR* ON LOST INSTINCTS.

The need of spreading abroad scientific knowledge is never, I think, made more apparent than in the articles which appear in our first class-journals: but one does not often meet with such evidence of the absence of the most elementary knowledge (biological in this case) as is given by the writer of what appears to be intended as a serious dissertation on "Lost Instincts," in last week's *Spectator*. This gentleman appears to suppose that under the modern evolutionary doctrine man "is the heir of *all* (!) the various species and genera of the animal kingdom." Therefore he regards it as "a little sad that we should have inherited the one disastrous instinct of the [slavemaking] ant," seeing that we have not inherited the "architectural instincts of bees and beavers, nor the spinning instincts of spiders, nor the power of the dog to track out its home." With such a theory alive, we need not wonder, I suppose, that parasitism is so rampant and enduring amongst us, the greater proportion, by far, of animal species being parasites. I trust that the writer reaps some comfort from the fact that, since we were Hessian flies, the practice of the embryo eating the inside of its larval-mother before it sees the light has been given up. Parthenogenesis has also, since we were aphides, been discarded, for good or evil. But, alas! in too great a fondness for a warm bed, how many of us declare our descent from an insect that need only be referred to to be recognised. FRANCIS RAM.

ANCIENT HISTORICAL ECLIPSE OF THE MOON.

According to Josephus ("Antiq." b. xvii., c. vi., sec. 4) there was an eclipse of the moon but a short time before the death of Herod the Great.

I have seen it stated, apparently on the authority of astronomers, that there was no other eclipse of the moon, visible at Jerusalem, in any year that can be taken into account for the death of Herod, besides the one that happened in March, B.C. 4. As, according to the Chaldean Periods, there was an eclipse of the moon due on the night of January the 17th, B.C. 2, about 6·30 p.m., and as all the best ancient historical testimonies to the time of the birth of Christ, concentre in the autumn of the year B.C. 3, I distinctly challenge the above statement, and I affirm that there was an eclipse of the moon visible at Jerusalem about 6·30 p.m. on the night of the 17th of January (19th of January, if the Calendar had been properly kept), B.C. 2. If any of our astronomers choose to support the challenged statement, and will put in a proof calculation from Saturday night's eclipse, to show that there could not be an eclipse at that time, then I will reply with one or more proofs to show that there was an eclipse.

J. DE D.

FROSTED VEGETABLES.

Can any of your readers give a chemical explanation of the changes which certain vegetables, *e.g.*, potatoes, undergo if exposed to frost? From their sweet taste it would almost seem as if a part of the starch in the tubers had been converted into glucose. Is this correct? If so, how is it effected, and is the process capable of utilisation?

NEW SUBSCRIBER.

BRITISH SPECIES OF VIPER.

Your correspondent "R. M. N.," in the SCIENTIFIC NEWS of Jan. 13th, is correct in supposing that vipers vary in colour, according to the locality in which they live. The black viper is found in peat and turfy districts; the viper with yellow markings abounds in chalk banks, and the red viper in red earth or gravelly soil. They are but varieties of the same species. C. A. M.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS, *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

POLISHING FLUID.—A liquid for polishing metals, formed by mixing together water, sulphuric acid, and rottenstone, has been patented by Mr. W. C. Poult, of Pearson-street, Clapham Junction, S.W., and F. Ryan, of Falcon-road, Clapham.

HEATING APPARATUS.—An apparatus for warming schools has been patented by Mr. W. P. Thompson, as a communication from J. D. Smead, of the United States. In place of a fire, fresh air is admitted from outside into a heater resembling a locomotive boiler, with this difference, that the fresh air brought by a conduit from outside the building takes the place of water, and is caused by the position of the entrance and exit pipes to largely traverse the "boiler" before escaping.

AUTOMATIC STRENGTH-TESTING MACHINE.—Mr. W. J. Oliver, of Canonbury, London, N., has patented a coin-freed dynamometer. The dynamometer is for testing the force of a blow. A padded rod is driven in when a locking catch is withdrawn by the vitalising of the magnet. This is effected when a coin falls down the shoot and connects the terminals on a tray. The inward movements of the rod tilts the coin-tray by means of a projection acting on a tailpiece attached to the coin-tray.

METHOD OF WELDING STEEL.—Mr. W. B. Middleton, United States, has patented a method of welding steel. In the practice of this invention highly satisfactory results have been obtained by applying a solution of silicate of soda to the pieces of steel to be welded, by dipping them in the solution, or by pouring it upon them; bunching together the pieces to be welded, and heating them to an ordinary welding heat, and then passing them through welding rolls of ordinary construction.

SIGHT FOR FIRE ARMS.—A wind-gauge sight for fire-arms has been patented by Mr. H. J. Allison, as a communication from Mr. W. Lyman, of the United States. The invention relates to a wind-gauge sight, and has for its main object to provide for the lateral adjustment of the line of sight to compensate for the action of the wind upon the projectile. The invention consists chiefly in the combination of a sight post with a conical eccentric, which is seated in a suitable base and adapted in its rotation to swing the sight in a conical path.

PORTABLE BATH.—Mr. C. J. Etherington, of Chancery-lane, London, has patented a portable bath. A lattice framework is made of laths, which are so joined together as to permit the framework to expand to a diameter of several feet or to contract to the space of a few inches. Over this framework when expanded is placed a piece of waterproof sheeting of such size and in such a way that when depressed in the centre it will overlap the framework forming the sides of the bath. This waterproof sheeting, supported by the framework, forms the bottom and sides of the bath.

TELEPHONE.—Mr. A J. Boult (as a communication from Mr. J. C. Reiff, of New York, U.S.A.) has patented

a telephone. The invention relates to make-and-break transmitters producing intermittent electric currents. In this instrument the diaphragm, which is preferably of glass or mica, is stretched in a frame attached to a block, in which the mouthpiece is arranged in a position such that the air waves fall obliquely on it; an air passage is provided all round it, also an exit hole. The electrodes, which may be of carbon, are fixed one on each side of the diaphragm, and are both connected to one pole of the battery. Two adjustable points with which they make a break contact are in connection with the other pole.

Safety Lamp Burner.—Mr. W. Notley, of Peckham, London, has patented a safety lamp-burner. The burner protects the oil in the reservoir from ignition by enclosing the wick in a porous chamber encased at its sides in a metal tube, or at the sides and base with wire gauze, twenty-nine meshes to the inch, through which the flame cannot pass to the oil or the vapours in the reservoir, but which will permit the oil to permeate through to feed the wick; and the ignition of any oil contained in the wick case at the moment of the overturning of the lamp is prevented by an automatic extinguisher, forming part of the burner, which extinguishes the flame before the lamp can have passed so far from the vertical as to permit the oil to reach the flame.

Miners' Gas Tester.—An apparatus for the detection of gases in mines has been patented by Mr. J. W. Swan, of Lauriston. The apparatus consists of a transparent glass tube open at both ends, except that the ends are covered by wire gauze. In this tube is a metallic wire so arranged that by means of a switch it can be either included in or excluded from the circuit of a battery. The tube containing the indicator wire is preferably enclosed in a casing of ebonite with an opening in one side for observing the wire. The wire gauze diaphragms which cover the ends of the glass tube are circular. In using the apparatus the electric current is turned on by means of the switch and the degree of brightness of the indicator wire observed. The ends of the tube are then closed (by finger and thumb), and any change in the degree of brightness of the wire when the ends of the indicator tube are closed noticed. This will give the required indication, as, if firedamp be present, the wire will be brighter when the indicator tube is open than when it is closed.

Telemeter.—Mr. W. H. M. Christie, of the Royal Observatory, Greenwich, Kent, has patented a telemeter. At both ends of a tube are fixed two reflectors which receive pencils of light from the object, whose distance is to be determined through two apertures, the reflectors are inclined at 45° to the axis of the tube, and so direct the image of the object through two object glasses to the same number of mirrors, also inclined at a similar angle so as to turn the rays of light into an eye-piece. Each object glass may be made adjustable longitudinally in the tube, but one of the object glasses is also adjustable transversely by means of a micrometer screw with a graduated disc. Two images of the distant object are seen in the eye-piece, the distance between them being greater the nearer the object. The lens, which is adjustable transversely, is moved by the micrometer screw, until the images coincide or come into some definite relative position, when the range is read off on the graduated disc.

ANNOUNCEMENTS.

Bombay Technical Institute.—Sir Dimshaw Petit has presented the Bombay Government with a property valued at 300,000 rupees as a donation towards the establishment of the proposed institute.

Government Research Grant.—Applications for assistance from the Government grant of £4,000 for the promotion of scientific research must be forwarded, with particulars of the proposed research, to the Secretaries, Royal Society, Burlington House, before the end of March next, upon printed forms to be obtained of the assistant-secretary.

Oxford.—The Vice-Chancellor has announced that Mr. A. H. Green, M.A., F.R.S., F.G.S., formerly Fellow of Caius College, Cambridge, now Professor of Geology in the Yorkshire College, Leeds, has been elected to the Professorship of Geology. Professor Green was sixth Wrangler in 1855. He is the author of a manual of geology and various geological memoirs.

Patents in India.—The proposed new Patent Bill provides for fourteen years' protection for inventions. The charges will be as follows:—On application for provisional protection, ten rupees; on filing complete specification, thirty rupees. After the expiration of four years from the date of the patent, the annual charge will be for the next five years 50 rupees, and for the last five years 100 rupees.

Meteorological Exhibition.—The Council of the Royal Meteorological Society have arranged to hold, at 25, Great George Street, Westminster, on March 20-23 next, an exhibition of apparatus connected with atmospheric electricity, including lightning-conductors, photographs of lightning, and damaged objects. The Committee will also be glad to show any new meteorological instruments or apparatus invented or first constructed since last March; as well as photographs and drawings possessing meteorological interest.

Observations of Hail and Thunder Storms.—A committee has been appointed by the Council of the Royal Meteorological Society, to collect observations on British hail and thunder storms from volunteer observers. The objects which they hope to attain thereby are:—(1) A knowledge of the nature and causes of the different kinds of thunder-storms, their attention having been specially called to the subject by the great loss of life and property during the past summer. (2) A discovery of the localities where hail and thunder are most frequent and destructive. (3) If possible, to obtain an increased power of forecasting hail and thunder, whereby they hope that eventually damage to persons, stock, and property might be lessened. Forms and instructions will be sent to intending observers on application to the Secretary of the Royal Meteorological Society, 30, Great George-street, Westminster, S.W.

Natural Science Postmastership at Oxford.—There will be an election at Merton College on June 30 to one; Natural Science Postmastership of £80 per annum. Candidates for this Postmastership must not have exceeded 19 years of age, nor (if members of the University) six terms of University standing, on the day of election. The examination will begin on Tuesday, June 26, at 10 a.m. The subjects for examination will be chemistry and physics. There will be a practical examination in chemistry. Candidates will have an opportunity of giving evidence of a knowledge of biology; but the examiners will look for evidence of an acquaintance with the principles of chemistry and physics at least equal in extent to that which is required in the Preliminary Honour Examination in the Natural Science School. Candidates who wish to be examined in biology must give at least a week's notice to the Tutor in Natural Science. A paper will be set in algebra and elementary geometry (Euclid, Books I.-IV.) and a classical paper of the standard required by the University of Responsions. Further information may be obtained from the Tutor in Natural Science.

DIARY FOR NEXT WEEK.

Monday, Feb. 27.—London Institution, at 7 p.m.—*Music, Emotion, and Thought;* Rev. H. R. Haweis.
Bradford Naturalists' Society, at 7·30 p.m.—*Life History of some of the Lepidoptera;* Mr. B. Illingworth.
Cleveland Institution of Engineers, at 7·30 p.m.—*The Working of the New Patent Law;* Mr. G. J. Clarkson.
Society of Arts, at 8 p.m.—*The Modern Microscope;* Mr. John Mayall, junr.

Tuesday, Feb. 28.—Royal Institution, at 3 p.m.—*Before and after Darwin;* Professor G. J. Romanes.
Institution of Civil Engineers, at 8 p.m.

Wednesday, Feb. 29.—Civil and Mechanical Engineers' Society, at 7 p.m.—*Our National Defences;* Mr. W. C. Street.
Dundee Naturalists' Society, at 8 p.m.—*Notes on Zoogeography;* Mr. James Coates.
Cardiff Amateur Photographic Society, at 8 p.m.—*Spirit Photographs;* Mr. D. Josti.
Royal Dublin Society.—*The Making of Ireland. Epoch I. The Mountain Limestone;* Professor W. J. Sollas, F.R.S.
Society of Arts, at 8 p.m.—*Discussion of the Technical Education Bill.*

Thursday, Mar. 1.—Royal Institution, at 3 p.m.—*Early Secular Choral Music;* Professor C. H. H. Parry.
London Institution, at 6 p.m.—*Glimpses into the Parochial History of the City of London, as gathered from the Records;* Dr. Edwin Freshfield.
Parkes' Museum of Hygiene, at 5 p.m.—*Milk and Disease;* Mr. G. Sims Woodhead.

Friday, Mar. 2. —Royal Institution, at 9 p.m.—*Poisons and Poisoning;* Dr. C. Meymott Tidy.
Royal United Service Institution.—*The Native Army of Bengal;* Major-General J. J. H. Gordon, C.B.
Royal Dublin Society.—*The Making of Ireland. Epoch II. Coal.* Professor W. J. Sollas, F.R.S.

Saturday, Mar. 3. —Royal Institution, at 3 p.m.—*Experimental Optics;* Lord Rayleigh.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

Fretwork Carving.—Catalogue of all requisites and 500 miniature designs free, 6 stamps.—HARGER BROS., Settle.

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Sikes' Hydrometer, complete, weights, thermometer, trial glass. Instruction. Warranted, 30s.—A. TOWNSEND, Hereford.

Camera, 8 by 5, slide and rectilinear lens, first class. Accept 110s.—EDWARD HUGHES, Graigue, Kilkenny.

"Playground of Science," just ready, containing novel, simple, and interesting scientific experiments, illustrated. One Shilling, post free.—TRUSLOVE AND SHIRLEY, 7, St. Paul's-churchyard, London.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Wanted, Cabinet for Specimens, with not less than 12 drawers, about 3 ins. deep. Send sketch and particulars addressed D., care of Publisher, SCIENTIFIC NEWS, 138, Fleet-stret, E.C.

Crayon Sketch from any photograph (returned uninjured), 15 by 11, 1s. 2d. free.—MR. COULTHARD, Bathwick, Bath.

100 Fretwork, 200 turning patterns, 300 stencils, 50 conjuring tricks; 1s. each —COLLINS, Summerlays-place, Bath.

Microscope, French, 3 powers, 3 objects, forceps, in case, good condition, for 20s. cash, books, or collection of postage stamps.—H. MONCKTON, 1, Hare-court, Temple, London.

Lancaster's Instantograph Half-Plate, complete, in case, 2 double backs, printing frames, dishes, etc., all equal to new.—E. SANGER, Rectory, Dursley.

Telescope, sling leather case, by Stewart, first-class condition, powerful lenses, price 30s., or exchange for pair of field glasses.—E. C. W., 13, Ashbury-road, Lavender-road, S.W.

Meerschaum and Briar Pipes repaired, mounted, or cased; ambers fitted.—W. GEORGE, 324, Essex-road, Islington, London.

Trouser Lengths, 5s., Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—HEWITT, 27, Winfield, Leeds.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Wanted, last Edition of Ure's "Dictionary of Chemistry," in exchange for a microscope.—L. BROCKWEIR, Gunnersbury.

Wanted, Mahogany Slide Case to hold 72 microscopic slides; also double nose-piece, bent form. Will give in exchange microscopic slides, unbound volumes of magazines, or netted hammock.—T. H. BOORMAN, Tenterden.

Four-and-a-half in. Equatorial Reflecting Telescope, divided circles, two eye-pieces, all adjustments; particulars on application; open to offers.—HOLMES, 149, Essex-road.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

The Story of Creation. By E. Clodd. London: Longmans, Green, and Co. Price 6s.

Treatise on Photography. By Captain W. de W. Abney. Fifth Edition. London: Longmans, Green, and Co. Price 3s. 6d.

Short Studies from Nature. London: Cassell and Co.

Playground of Science. By Johnston Stephens. London: Truslove and Shirley. 1s.

Lectures on Electricity. By George Forbes. London: Longmans, Green, and Co. Price 5s.

An Easy Guide to the Constellations; with a Miniature Atlas of the Stars, and Key Maps. By the Rev. James Gall. London and Edinburgh: Gall and Inglis.

Management of Accumulators and Private Electric Light Installations. A Practical Handbook. By Sir David Salomans, Bart. Third Edition. London: Whittaker and Co.

The Earth's Story. By Dr. Brown. London: Cassell and Co.

Weather. By Ralph Abercromby. International Scientific Series. London: Keegan, Paul, and Co.

First Year of Scientific Knowledge. By Madame Paul Bert. London: Relfe and Sons.

NOTICES.

The Title Page and Index to Vol. I., *First Series,* now ready, price 6d.

Binding Cases for Vol. I., *First Series,* price 2s. each.

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Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

FOOD ADULTERATION.—The report of Dr. Sedgwick Saunders, the Public Analyst for the City of London, which has just been issued for 1887, contains some interesting particulars. During the past year the number of samples examined in the City was 294, including 59 of arrowroot, 18 of beer, 4 of bread, 15 of butter and butterine, 20 of coffee, 13 of disinfectants, 37 of drugs, 2 of extract of meat, 18 of gin, 57 of milk, 22 of mustard, 3 of pickles, 8 of pepper, 2 of rice, 14 of rum, 4 of tea, 18 of water, and 34 of whisky. Three milkmen were prosecuted and fined, but most of the samples were found to be genuine and unadulterated. Periodical examinations of the New River water supply to the City were made with the usual satisfactory results. On the other hand, as might be expected, the samples of well water from the City of London Cemetery at Ilford were more or less contaminated. Respecting coffee, Dr. Saunders says there is little doubt that when ground it is largely mixed with chicory—as much as 40, 50, and even 60 per cent.—but he thinks that this is a recognised custom in the trade of the retail grocer, especially in the poorer districts, and that, as a rule, the purchaser is aware of the fact. It may be a custom of the trade, and our poorer brethren may from necessity or expediency put up with it, but it is hardly creditable that such an adulterated mixture should be sold as coffee. If it be wrong to sell butterine or margarine for butter, surely it is equally wrong to sell chicory for coffee.

Dr. Saunders mentions that the Local Government Board estimate that Londoners are paying between £60,000 and £70,000 a year for water sold under the name of milk, but that the leniency of justices make it difficult to deal with this adulteration. In one district alone the analyst reported that the milkmen received between £7,000 and £8,000 a year for water, while the total fines inflicted amounted to £100 only for that period. Milking the pump may be very profitable to the so-called "milk"-man, but the harm done in many cases to young children who are mainly dependent on having *bona-fide* cow's milk of good quality is incalculable, and when adulteration of this kind is proved the full fines should be inflicted. Leniency is altogether misplaced. In the matter of spirits, it appears that for some years past about 23 per cent. of the total number of samples examined under the Act in England and Wales have been found adulterated with water, but this form of tampering does not obtain to an appreciable extent in the City of London. As regards tea, it is very satisfactory to know that out of 511 samples examined by public analysts only one was reported to be adulterated.

MODERN ADVERTISING.—A queer instance of the ruthless way in which the advertiser of to-day treats all things, good and bad, as *material*, is afforded by a little advertising book circulated by the owners of Holloway's Pills. It contains a calendar setting forth exactly the diseases we may expect in each month, and exactly how we should treat each and all of them with the pills internally and the ointment externally; and it gives many valuable and interesting but not wholly accurate and scientific items of knowledge; among them standing out conspicuously a sober revival of the old notion of the

hibernation of swallows in ponds, and the possibility of getting them out during the winter in clusters and thawing them to life! And in the same book we find an account of the Holloway Sanatorium for the scientific treatment of the insane, and the Holloway College for the promotion of the higher education of women. Let us hope that the pill owners who have made such unseemly use of these institutions by dragging them into the advertisement will not carry into their management the views of medicine and of science which it represents.

Sir John Lubbock on Free Libraries.—Sir J. Lubbock, in presiding at a meeting held at Tunbridge Wells in support of the proposed free library, urged that hours of leisure should not be hours of idleness, and that the free library would prove a useful school for the grown-up. He remarked also that the literature of England was the birthright and inheritance of every Englishman, and that England had produced, and was producing, many of the greatest poets, philosophers, and men of science. No country could boast a brighter, purer, or nobler literature, richer than our commerce, more powerful than our arms, the true pride and glory of our country. As regards the cost of free libraries, he doubted very much whether they would cost the ratepayers anything, and he thought they would indirectly save more than the penny rate.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams., F.R.A.S., F.C.S.

On page 103 of this magazine is a reference to the "Spectre of the Brocken," as seen on Arthur's Seat lately, and to the editor's experience on the summit of the Milleschauer in Bohemia. I have seen it twice on Arthur's Seat, the first time quite unexpectedly when a student in Edinburgh. I was on the summit just before sunset. The city and surrounding country was enveloped in a mist or ground fog which reached nearly to the top of the hill, and seen from where I stood, had the appearance of a white billowy ocean stretching on all sides to the horizon. Presently I saw a gigantic ghostly figure suddenly start up before me, and as suddenly vanish. Then another and another apparition, and disappearance. Two boys were playing near, and I called them to stand beside me, and look to the eastward. In a few minutes three ghosts started up, the largest with waving arms—they were mine. The boys were frightened, and ran away.

I remained to study the conditions, and found that the spectre appeared whenever a waif of mist rose high enough to envelope me. A shadow of myself was then thrown not *upon* it, as on a screen, but bodily *through* it. The gigantic stature of the shadow was an illusion. Careful examination showed that it was no taller than myself, and no broader, but its horizontal dimensions were very great; it extended a long way through the mist, the legs appearing greatly magnified in length, as the feet of the shadow began at my feet, and all the rest extended forward as well as upward. Presently the sun set, and, of course, the show was closed.

The second time was some years after this. I was in the city on a misty day, but the mist intercepted very little light, and, therefore, could not extend far upwards. About an hour before sunset I climbed the hill with the express purpose of renewing my acquaintance with the spectre, and was not disappointed, though it was less vivid than on the first occasion, and permanent; this time the mist rising generally rather higher than the summit of the hill, and intercepting some of the sunlight. The horizontal projection was, however, still more plainly shown.

I have no doubt that it may be seen on this or other isolated peaks several times in the year, but is not seen, for the simple reason that people do not climb such hills in misty weather. But tourists make a mistake in not doing so. No landscape can be finer or more curious than the effect which is displayed after climbing through an ocean of cloud and emerging suddenly into clear blue sky and sunshine. The illumination of the cloud tops is at times most brilliant, and the scene is always weird and curiously suggestive of transfer to another planet, to an inverted world, where the cloudy sky is below and the clear blue ocean above.

We are an extravagant people in most things. We waste our fuel most recklessly and shamefully, so shamefully that ere long we shall be one of the poorest nations of the world as regards coal supply. We shall have finished our best and most available coal seams when our neighbours will have fairly started the working of theirs. "An Englishman's fireside is a disgrace to the nation; a barbaric grating set in a hole in the wall, consuming one of the greatest of our physical blessings, in such wise that eighty per cent. of the heat passes up the chimney to warm the clouds. The wife of a French peasant feeds her husband and family at little more than half the cost expended upon feeding the same number in the household of an English artizan, and feeds them better, by her more skilful and economical cookery.

But the worst extravagance of all is that of pouring into the rivers and the sea all the sewage of our towns. The raw material of our food is twofold: one portion is the water and carbonic acid which the plant by means of its leaves obtains from the air. This we return to the air by respiration; we do not waste it, simply because we cannot.

The other is the mineral and nitrogenous matter obtained from the soil by the roots of the plants. Unlike the atmospheric material, the natural supply of this is severely limited, and should be religiously economised. Therefore we deliberately and elaborately waste it.

The old cesspools were very bad, but the material they contained was buried in the earth, to be utilised at some future time somehow. Now we drench it with water, and at great cost fling it all into the sea beyond reach of recovery, and in doing so we commonly pollute all the natural channels to the sea. The rivers, that should be pellucid and beautiful, and teeming with fish, are made filthy, hideous, and barren. We perpetrate this criminal folly in spite of the fact that a simpler and better way has been clearly and fully demonstrated, a way by which all that has been taken from the soil may

be returned to it, and render it perennially fertile without any guano or coprolites, or quack nostrums in the shape of artificial manure.

It has been proved to demonstration that by having a double set of conduits, one for interior house drainage, another for rain water (a tube for carrying the former laid within the brick sewer that carries the latter will do it), we can easily pump the valuable sewage away as fast as it is produced, and carry it, while fresh and valuable, as many miles as necessary for distributing over the land that needs it, whatever the level of that land may be.

In the Journal of the Society of Arts of December 9th is a most valuable letter, by that able and veteran sanitarian, Edwin Chadwick, which lets the daylight very distinctly into the alleged failures of this simple and natural solution of the difficulty. The sewage farms are doubly jobbed. The farming tenants of the Corporation, as Mr. Chadwick mildly puts it, are not in the habit of considering that they are obliged to disclose the profits of sewage farming; "indeed, they generally be-little them, from apprehended increase of their landlords' unearned increments."

On the other hand, the landlords fleece the Corporations by charging rentals of double, quadruple, and even tenfold value. Thus above £10 per acre is extorted at Croydon for agricultural land worth 23s. In another case he mentions, the "right hon. landlord exacted £4 per acre" for land previously let at 10s., and now of course worth much less than 10s. In these cases sewage farming does pay—somebody; but the profits, like the handkerchiefs and watches of Mr. Fagin's establishment, are transferred to the wrong pockets.

NATURAL GAS.

OUR readers are aware that in Pennsylvania and other parts of the United States large quantities of natural gas which issue from the earth are collected and conveyed long distances in pipes to places where it can be used for heating and lighting. According to an American contemporary, the gas field of Murrysville is now one of the wonders of the world. One hundred and twenty-five wells, within a radius of one mile, are pouring forth a truly astonishing volume of gas. It is said that there is no perceptible diminution in the flow of gas, while it is estimated that on an average each "well" yields daily from 50,000,000 to 75,000,000 cubic feet. If we take 60,000,000 as the mean quantity, and multiply this by 125, the total yield reaches the enormous volume of 7,500,000,000 cubic feet per diem! There are now fifteen gas-pipe lines conveying the gas to as many different points for use.

GAS WELLS AT FORT SCOTT, KANSAS, AS SEEN AT NIGHT.

From the fact that the flow is so immense, and that the pressure is so well maintained, it is generally supposed that a constant generation of gas must be going on beneath the earth's crust. Occasionally reports get afloat that such and such a well is giving out, but a good authority states that in every instance it has been found that the decreased pressure has been caused by some obstruction in the piping, and that when this was removed the original pressure was restored.

The natural gas escapes from the earth at a very high pressure, seldom under 100 pounds on the square inch, and often much more. If, then, we remember that the pressure of the gas we are accustomed to use in our houses has a pressure of only about one-twelfth part of a pound to the inch, some idea may be formed of the almost unmanageable pressure in Nature's gas works. This high pressure is a distinct advantage for the purpose of conveying the gas long distances, as much smaller pipes can be used, but the practical difficulties attending the use of gas at a pressure of only a few pounds to the inch are very considerable. The high-pressure gas is usually passed into gas-holders weighted to a convenient pressure for town distribution, but even this device is not entirely free from risk. In Millerstown, Pa., on the 28th December last, the inhabitants were startled to find that the gas flames in their houses shot up a foot or so in height, and almost immediately afterwards they were dismayed at seeing the flames reach the ceilings. Fortunately prompt action was taken, or the town would have been destroyed. The cause of the mishap was that the ball of a regulating valve at the holder either fell off or was removed, so that the full natural gas pressure was thrown on the mains and service pipes.

Our illustration, taken from *Scientific American*, represents a group of gas wells at Fort Scott, in Kansas, as seen at night. These wells form one of the great natural resources of the district, and at present there is more gas than can be used, although pipes are laid throughout the town for supplying light and fuel to everybody at a mere nominal cost. An increasing number of manufacturing industries is being established at Fort Scott, but in the meantime the scene at night time near the wells is described as very striking. The flames from the wells then look like gigantic torches, being twenty feet or more in height. The whole of the surrounding country is, in fact, illuminated by Nature's abundant provision.

STORMS.—I.

GREAT as has been the progress in the science of meteorology during the last twenty years, the precise theory of the mechanism of storms and the nature of cyclone currents has yet to be discovered; or, at all events, the somewhat contradictory hypotheses which have as yet been put forward must be harmonised and proved. Fortunately for the sailor, the "law of storms" has been expressed in so simple a manner that for the last half-century mariners have not only had a set of simple rules for instant action in a hurricane, but they have derived infinite advantage from them, and innumerable lives have been saved by the knowledge which enables them to avoid an approaching storm.

Before describing the nature of a cyclonic storm, it may be well to give a brief account of the causes which produce winds. Wind is the rush of air from a locality of high to one of low pressure. The reason for the difference of pressure is often very difficult to determine, and of two meteorological events it is frequently impossible to say which is cause and which is effect. The "trade-winds" are easily accounted for by the following facts. The air over the equatorial regions of the earth, becoming heated by the greater power of the sun, becomes rarified, and rises, causing a diminution of pressure. The air from the cooler regions of the north and south flows in to take its place, and the air which has risen moves towards the poles and becomes cooled, both by the actual decrease of temperature in the upper regions of the atmosphere and by the heat lost by the work done in its own expansion under the lower pressure. It eventually descends, and thus completes the circuit. The motion in the higher regions is therefore towards the poles, and the lower currents blow towards the equator.

Now, the surface of the earth at the equator moves at the rate of 24,800 miles per day, or seventeen miles per minute, and at the latitude of Constantinople or New York the velocity is about three-quarters, and at Christiania, on latitude 60, it is one-half as great. When a mass of air moves towards the equator the earth will outrun it, on account of the greater speed at which the surface is travelling. Instead of blowing north and south, the wind will be north-east and south-east. These regular winds are only found near the equator, but it must not be supposed that there are two belts, one on each side of the equator, in which these breezes blow steadily all the year round, as suggested by the maps in the "physical" atlases. They are considerably disturbed by the constantly changing winds in the tropics.

Every wind is part of a current circulating in a more or less closed course. It is evident that a wind must go somewhere, and that air must come from somewhere else to fill up the space which it has left. If the density of the air were uniform, and lay on the surface of the earth like an ocean, the depth would be a little less than five miles. But Mr. Glaisher has ascended in a balloon to a height of about seven miles, and the air, which was about one-third of the density of that on the surface of the earth, could be breathed, and sustained the balloon. The motions of a uniform ocean of air above us would be much less difficult to deal with, though it must not be imagined that they would be the same as those of water, for the great elasticity of the air introduces a number of other considerations, and the variation of its density at different heights complicates the matter still further.

Most people have noticed that it is very difficult to empty a basin having a plug at the bottom without setting up a whirlpool. The same is to be seen in emptying a funnel. The reason is similar to that which has been given to account for the westerly direction of the trade-winds. Any small portion of the water which happens to have a circular motion (and any motion in the basin which is not radial must be to some extent circular) will have its angular velocity increased when it is drawn towards the centre, as it has a smaller circle to travel in.

When a mass of air rises by becoming warmed, there will be an inrush from all sides near the surface of the earth to take its place, and there will almost invariably be a tendency to circular motion, slow at the outside and more rapid as it approaches the centre, where the stream turns upward. From causes which are not very clearly understood, the direction in the northern hemisphere is almost always contrary to that of the hands of a watch,

and in the reverse direction in the southern hemisphere. Such a whirlwind is called a cyclone. It is not necessarily a storm. Its diameter may be from one to two thousand miles, but in imagining it as an inverted whirlpool we must remember that it is only about ten miles deep. In the northern hemisphere cyclones move in a general east-north-easterly direction, at a rate of from 100 to 1,000 miles a day.

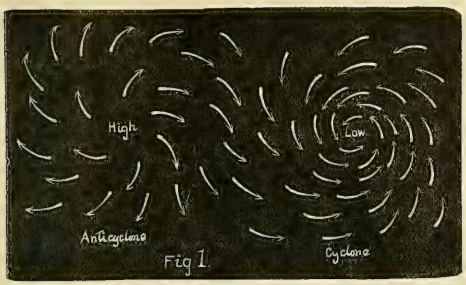


Fig 1.

The barometer is lowest at the centre, and rises gradually as the outside of the cyclone is approached. It must not be imagined that such a depression of the barometer indicates a corresponding depression of the atmospheric ocean above us, for there is reason to believe that in high levels the depression disappears, and it is not improbable that at a height of 15,000 feet or so the pressure is greater over the centre of a cyclone than at its extremity.

We may find an analogy in the currents of a swiftly-flowing river. The friction of the bottom retarding the water, the velocity near the surface is greater than near

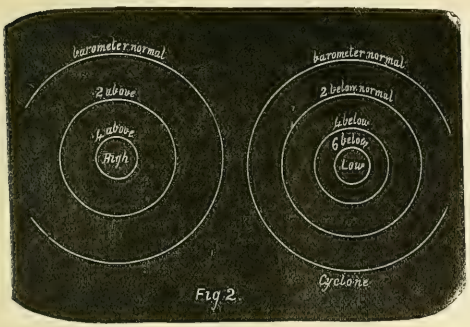


Fig 2.

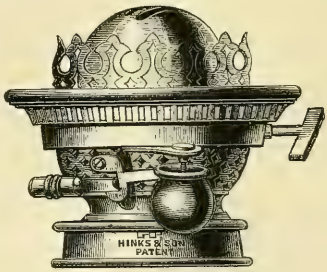
the bottom. This would tend to make the upper part run away from the lower; but the deficiency is met by an occasional uprush of water from the bottom, and it is generally carried a little above the surface by its momentum, forming a swelling from which the water spreads radially. The uprush is evidently due to a reduction of pressure, which sucks the water upward, and the swelling above the surface of the stream is of course attended by a slight rise of pressure near the surface. There is no evidence to show there are currents in the upper regions of the atmosphere of sufficient strength to give rise to cyclones in this manner, but the analogy may assist the reader to imagine the circulation of the currents.

When the air from the upper regions descends a rise of pressure is noticed, and there is a circular motion, not so strong as in a cyclone, but very clearly defined. It is less easy to imagine why there should be a circular motion in this case, especially when we find that the direction is always opposite to that of a cyclone, viz., in the direction of the hands of a watch. Such an area of high pressure is called an anti-cyclone. The direction of the currents of air at the surface of the earth is represented in fig. 1, an anti-cyclone being shown on the left and a cyclone on the right. There is a large area of calm in the centre of an anti-cyclone. fig. 2 is a diagram of the state of the barometer, and is supposed to represent the same district as fig. 1. A line is supposed to be drawn through all places where the barometer is at the same height.

(*To be continued.*)

NEW SAFETY LAMP.

MESSRS. HINKS AND SONS have patented a new safety burner for oil lamps, of which we give an illustration. The burner is provided with an extinguisher, which acts automatically the moment the lamp is a little out of the perpendicular, so that if the lamp is knocked over by accident the flame is extinguished before the oil reservoir has had time to come



HINKS' SAFETY LAMP.

in contact with the ground. The way in which this is done is exceedingly simple. The lever shown to the left of the illustration is attached to a spiral spring, and the instant the little catch, shown to the right of it, is released the spring causes the extinguisher to fly up and put out the flame. The heavy ball to the right is suspended from a ball and socket joint, which permits it to move freely in all directions. When moved out of the perpendicular it pushes up the collar attached to the catch and thus releases the extinguisher lever. We tried the effect of slowly inclining the lamp so as to cause the ball to act very slowly, but in no case did we succeed in tipping the lamp more than 45 degrees before the extinguishing action came into play. The invention is ingenious, and the mechanism is not liable to get out of order.

DR. DALLINGER ON THE DECOMPOSITION OF ORGANIC MATTER.

AT the conclusion of the fourth year of his presidency of the Royal Microscopical Society, Dr. Dallinger delivered to the assembled Fellows of the Society a very interesting address, summarising the results of his own researches in a very important department of micro-biology.

Time was, and that not long ago, when it was believed by men of learning that the dead animal, or plant, reverted spontaneously to its elements, or at least to exceedingly simple compounds. Time was also when such processes as decay or putrefaction were considered of little importance to man or to the world at large. All this has now been changed. Thanks to the labours of Pasteur and others, we now know that, but for the labours of certain almost invisible beings, the lifeless remains of plants and animals would encumber the earth for an indefinite time, and that grand cycle of changes by which death is made the basis of new life could not occur. The destructive process which we call putrefaction, and for which some of us profess a lofty disdain, is simply a kind of fermentation. Just as a yeast-cell sets up the alcoholic fermentation in a solution of sugar, splitting up the sugar into carbonic acid and alcohol, so a putrefaction-cell sets up a series of changes in a solution of defunct organic matter. If we take meat broth, or albumen, or milk, or, instead, a decoction of wheat-grains, or of peas, or tea-leaves, and "sterilise" it by a sufficiently prolonged heat, and then keep it in air which has been perfectly freed from "germs," it will keep for any length of time without change. But if we introduce the smallest particle of matter which is already putrefying, or if we even admit the ordinary air, which is always rich in germs, decomposition at once sets in. All this has been known for some time, but Dr. Dallinger has thrown a new and most instructive light upon the whole process. It has been generally supposed that this change was effected solely by one or two species of bacteria. No doubt the first attack in such cases is ordinarily made by *Bacterium termo*. We never find a decomposing solution of albuminous matter in which this form is not abundant. But if we cause large masses of animal or vegetable matter to lie in water at ordinary temperatures, and carefully follow, as Dr. Dallinger has done, the course of decomposition, we see that the process is effected not by one single organism, but by many, which succeed each other in a regular manner. Each set in turn makes its appearance at some fixed stage, takes up the work, feeds and multiplies, and in so doing prepares conditions suitable for its immediate successor.

Beginning with *Bacterium termo*, this minute plant makes its appearance in the fluid surrounding a mass of decaying fish or flesh, and multiplies at a wonderful rate. It seems to cover the putrid matter with a kind of film, whilst offensive and noxious gases and vapours are being thrown off. In the course of a week or more, according to the weather, certain spiral forms appear, which are constantly in motion. They invest the putrefying tissues, and render them soft and pulpy. Then come a series of monads, which Dr. Dallinger has more particularly studied. Yet the exact parts which they take in the process, and the nature of the changes which each form brings about, will require much further examination.

These, again, are succeeded by other organisms, which at first swim and revolve, and glide about among the putrid matter.

One of these beings, known as *Heteromita rostrata*, is provided with a so-called "*flagellum*," a miniature whip-lash, which trails gracefully after it as it swims. This creature, at certain stages of its life, anchors in innumerable swarms—it is no exaggeration to say billions; by coiling the fibre it brings the body down to the point of anchorage. Then suddenly shooting it out, with a speed which the eye can scarcely follow, it brings it down like a hammer upon some point of the decaying mass. After resting for a second or two it repeats the operation. These tiny blows being thus constantly delivered over every part of the tissue gradually break it up, and cause it to disappear. Nor is *Heteromita rostrata* the only toiler thus employed. Other forms, some of them still more powerful, are at work. Thus after the lapse of from one month to three the entire mass of organic matter has disappeared as such. There remains merely in the glass or the pond, water of a pale grey colour and of noxious properties, charged with carbonic acid and carburetted hydrogen, whilst a fine, impalpable sediment of a buff colour is left at the bottom. What point of the process is most fraught with danger is by no means certain—not necessarily that at which the vapours given off are most offensive to human senses.

Dr. Dallinger is thus led to conclude that the most important of all ferments, that by which all dead organic masses are removed, is exceedingly complex, and includes the successive living action of a series of organisms specially adapted to this task, and for ever at work all the world over.

It is scarcely needful to say that this subject, here imperfectly sketched, has doubtless very important sanitary bearings.

Dr. Dallinger concluded his address by showing that the vital processes of the very simplest and lowest life-forms are as much guided and governed by immutable laws as the most complex and elevated. "The irrefragable philosophy of modern biology is that the most complex forms of living creatures have derived their complexity from slow and progressive variations and survival from the simplest forms. If, then, these simplest forms of the present and the past were not actuated by the same accurate laws of life, how did the rigid certainties that govern the more complex come into play?"

No fact really supports the supposed *abrupt* transformation of one kind of animal or plant into another, and there is no room in philosophy for such a supposition.

COLOUR BLINDNESS A BRAIN AFFECTION.

PROFESSOR RAMSAY believes that the particular defect giving rise to colour blindness lies, not in the eye itself, but in the brain. Certain persons, he points out, are incapable of judging which of two musical tones is the higher, even when they are more than an octave apart. Yet, as such persons hear either tone perfectly, the defect is not one of deafness. He accordingly argues that in such persons the brain is at fault, and thence proceeds to the assumption that it may be equally true that the inability to perceive certain colours is not due to a defect in the instrument of sight, the eye, but to the power of interpreting the impressions conveyed to the brain by the optic nerve. If this is the case, the problem is no longer a physical one. It falls among those with which the mental physiologist has to deal.—*The Medical Press.*

General Notes.

Snow in the Sahara.—On February 2nd flakes of snow fell at Laghonat in the Sahara, between 9 and 10 a.m. In the night there ensued a hail-storm.

The Sensitiveness of the Eye for Different Colours.—According to the recent investigations of Herr H. Ebert, the sensitiveness of the eye varies for different colours. By lamplight it is by far the greatest for green. After green, the eye appears most sensitive for red, then for greenish-blue, yellow, and least sensitive for blue.

Sculptured Stones in Britain.—The newly-appointed "Disney" Professor of Archæology at Cambridge, the Rev. G. F. Browne, B.D., gave his inaugural lecture in the Senate House. The subject of his first course is the English sculptured stones of the pre-Norman type. On the present occasion he took a general survey of the sculptured stones of the British Islands.

Interesting Discovery in Algeria.—According to the *Vigie Algérienne*, a well of boiling sulphurous water has been discovered in the neighbourhood of Thenobela on the banks of the river. In pursuing the digging the labourers came across a mill, supposed to be 1,600 years old. This led to some more digging in the hope of discovering the famous treasure which, according to the legend, Scipio Africanus had hidden in a cave.

Increase of Baldness.—Professor T. Wesley Mills criticises the theory (*Popular Science Monthly*) of Messrs. Eaton and Gouinlock, that the chief cause of baldness is the constriction of the blood-vessels of the head by tight hats, and gives it only a partial acceptance. He considers that "baldness is one more of the many warnings of our day, one of Nature's protests against the irregular and excessive activity maintained in this restless age."

A New Comet.—A new comet was discovered by Sawerthal, and observed at the Cape Observatory at 2h. 33m. a.m. on the 19th inst., when its position was R.A. 19h. 11m. 32.5s. (increasing 7m. daily); N.P.D. 146° 3′ 44″ (diminishing 1° 15′ daily). The physical appearance is described as "Seventh magnitude, nucleus well defined; tail 2° long; visible to the naked eye." It has since been seen in New Zealand and at Melbourne.

Republication of Galileo's Works.—We understand that the Italian Government have decided to issue a new edition of the works of Galileo at the expense of the State. The publication has been entrusted to Prof. Favaro, of the University of Padua, and he is endeavouring to make the edition as complete as possible. The work will occupy about twenty-five volumes, and it is not proposed to offer it for sale, but copies will be presented to the chief public libraries of the world.

The Ammonia-Soda Process.—It is not generally known that this process which threatens ruin to our once flourishing alkali industry is in origin a British invention. M. Solvay, with whose name the process is now commonly connected, has overcome certain practical difficulties in its working, chiefly of a mechanical nature. In like manner, certain foreign papers boast that the Thomas and Gilchrist "basic" process was only rendered capable of existence by Massenez, at Hoerde.

Purification of Water-Supplies.—At Atlanta, in Georgia, a system has been adopted for purifying the water supply of the town, which consists in a combination of the old Chinese method of treating suspicious waters with alum and filtering afterwards through sand. The quantity of alum used is, as in China, infinitesimal, and no bad effects can result to the consumers, seeing that if the proportions are properly adjusted no compound of alumina, soluble or insoluble, will remain in the water.

The Physiological Signification of Tannin in Vegetable Tissues.—M. Westermeyer (*Biedermann's Centralblatt*) holds that tannin is intimately related to the first assimilation products of the plant. Intensified action of light involves an increase of tannin, both in living cells, whether chlorophyll is present or absent, whilst in the normal chlorophyllous assimilation cells, if the chlorophyll is exceptionally absent, there is a corresponding deficiency of tannin. In the oak the tannin travels in summer from above downwards.

Poisonous Nature of Acacia Bark.—According to T. Emery the inner bark of the common white acacia of our gardens and shrubberies (*Robinia pseudacacia*, known in America as the "locust-tree") is decidedly poisonous. At the Brooklyn Orphan Asylum thirty-two boys were rendered seriously ill from chewing the inner bark of this tree. None of the cases terminated fatally, although very active treatment was found needful. It is remarked that a number of woody leguminous plants are found to contain poisonous alkaloids.

The Electric Light in Navigation.—As an instance of the value of the electric light in the navigation of dangerous waters, the *Electrical Review* mentions its successful use by vessels approaching Cay West in Florida. The channels leading to the anchorage are intricate, winding between reefs and shoals, and are marked by buoys and beacons. On the darkest nights, steamers plying between Tampa Bay, Cay West, and Habana run in and out of Cay West nearly at full speed, and it is interesting to watch the manner in which the marks are picked up by the powerful lights placed in the bows of these vessels.

New Magnetic Survey of France.—A new magnetic survey of France has been executed by M. Moureaux, under the direction of M. Mascart, Director of the Meteorological Observatory of the Parc St. Maur. The instrument employed has the advantage of weighing only about 9 lbs., whilst the Kew magnetometer weighs about 50 lbs. M. Moureaux has taken the precaution to select stations as remote as possible from railway lines, manufactories, etc.; but he does not seem to have attended to the geological character of the districts, especially the possible proximity of igneous rocks, or formations containing magnetic oxide of iron.

The New Forest Law in Russia.—The *St. Petersburg Gazette* believes that "the new law on the preservation of forests approved by the Council of the Empire will be enforced only partially in the thickly-wooded provinces of Archangel, Vologda, Viatka, Novgorod, Olonets, Perm, the districts on the left bank of the Volga, Kostroma, Nijni Novgorod, Kazan, and the Transcaucasus, excepting Stavropol. In all these provinces the law will only be applied to forests which the authorities of the Depart-

ment of Communications consider necessary for the preservation of the sources of rivers and their affluents as well as to the plots occupied by peasants of the domains."

EPIDEMIC AMONG SWINE AT MARSEILLES.—According to MM. Reitsch, Jobert, and Martinand (*Comptes Rendus*), the swine of Marseilles have been decimated by a disease hitherto unknown to the veterinarians of the district. It was introduced last summer by swine brought from Oran. The duration of the disease varies from three or four days to some weeks, and it generally proves fatal. Swine of the African breed seem less susceptible than others. The most characteristic feature found on *post-mortem* examination is extensive ulceration of the intestinal canal. It is not yet decided whether this disease is identical with the American *hog-cholera*, or with the *schweineseuche* of Löffler and Schütz.

BEAUTIES OF THE SPRUCE.—Mr. John Wilson, of Leazes Park, Northumberland, remarks that the spruce is distinguished from the true pines by having its needles scattered irregularly along the sprays. When young, the branches are horizontal or slightly turned upwards, but as they increase in size they become partially pendent, but still turn up at the tips. It flourishes in moist soils in the north of Europe. In the southern parts of Norway it flourishes on the mountains up to 3,000 feet above the sea-level, and in Lapland up to 1,000 feet. In stature it ranges from 120 to 180 feet. One of these trees, at Studley Royal, said to have been planted by Eugene Aram, is 133 feet in height, and 12½ feet in circumference. Its timber is light, elastic, and durable, taking a high polish. The resin of the tree is the source of Burgundy pitch, and the bark is used in tanning.

EARTH TREMORS NEAR SUNDERLAND.—A variety of phenomena have occasioned some excitement in the Sunderland district. Tremors have been experienced, not amounting to earthquakes, but enough to bring into question the common faith in the stability of the earth. An interesting fact is the gradual subsidence observed by Mr. T. W. Backhouse, of West Hendon House. For a number of years he has made a daily observation from a certain point in a back window of his house, of the summits of two prominent buildings which, seen from that exact point, were in a line. He had observed changes which show that either these two buildings—the Brick Works chimney and the cross on the Hendon Gas Works—had been elevated, or his house had subsided. The total alteration of level, since 1883, has been sixteen inches, five inches of which have occurred between July and November last. A recent careful survey of the district, executed by Mr. Frank Cass, a local architect, who was ignorant of the nature and details of Mr. Backhouse's observations, has fully confirmed this conclusion.

DESCRIPTION OF TABASCHIR.—H. Cohn (*Naturforscher*) states that this substance, much employed as a medicine in antiquity, and even yet in vogue in the Far East, consists of hydrated silica which is here and there deposited within the joints of the bamboo, though the history of its development is not known. Tabaschir is met with in two kinds, the one in its original condition as found in the bamboo, and the other after it has been submitted to calcination. The crude kind consists of generally cylindrical pieces of a grey, yellowish, or brownish colour, looking not unlike gum arabic. It contains a variable proportion of water, one per cent. of organic matter, and, in the dry state, 99·6 per cent. of silica, along with traces of iron oxide, alkalies, and lime. The organic matter consists of fragments of cells and of the ramified mycelium of a fungus. Tabaschir absorbs water and other liquids very greedily, and condenses gases energetically. It approximates to the opals, and especially to the hydrophanes, and in some points it resembles organic membranes. Tabaschir is probably the *saccharum* of Pliny and Dioscorides, a term which certainly was not applied to sugar.

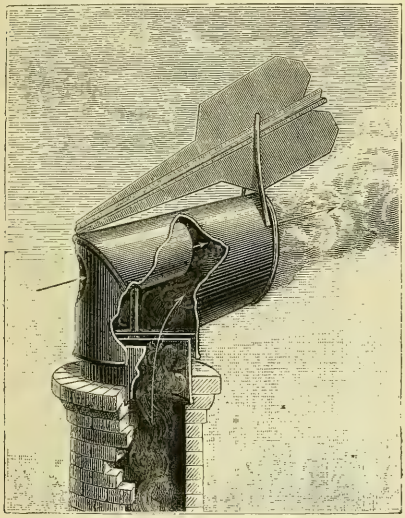
SOLIDIFICATION OF PETROLEUM.—We learn from the *Revue Scientifique* that the problem of solidifying petroleum has been taken up in Russia by Dr. Kauffmann, who is said to have obtained the best results by heating the oil for about half-an-hour with from 1 to 3 per cent. by weight of common soap. At the end of this time the soap is entirely dissolved, and the mixture is converted into a solid substance of the consistency of tallow. Cut into pieces in the shape of bricks, the petroleum thus solidified is ignited with difficulty; but once alight it burns slowly and without smoke, leaving about 2 per cent. of black, odourless residue. Compared with coal, its rate of combustion is about one-third as rapid, while the quantity of heat produced is far superior, when the draught is well regulated. In this solid state petroleum can be used in ordinary grates with little or no alteration. This method, which succeeds with the petroleum of the Caucasus, is not equally successful in the United States, and this is probably due to the difference in the composition of the petroleum in the two countries. However this may be, the question is an important one, and, when practicable, it is certainly better to modify this valuable fuel rather than to attack the problem by devising special apparatus for its use.

HEIGHTS OF WATERFALL.—The highest waterfalls in the world are the three Krimps Falls, in the upper Prinzgau, which have a total height of 1,148 feet. The three falls next in height are found in Scandinavia—the Verme Foss, in Romsdal (984 ft.); the Vettis Foss, on the Sogne Fjord (853 ft.); the Rjukan Foss, in Thelemarken (804 ft.). With a decrease in height of 213 ft., the three Velino Falls (591 ft.), near Terni, the birthplace of the historian Tacitus, follow next, and are succeeded by the three Toso Falls, in the Val Formazza (641 ft.). The Gastein Falls, in the Gastein Valley (469 ft.), are midway between the Skjaggedal Foss, in the Hardanger Fjord (524 ft.), and the Boring Foss, in the same fjord. The great Anio Cascade, near Tivoli (315 ft.), appears small by the side of the foregoing, but is still larger than the Falls of the Elbe in the Riesengebirge which are only 148 ft. high. If the width of the falls is taken into consideration, the most imposing are those of the Victoria Falls of the Zambesi, which are 394 ft high, by a width of 8,200 ft. A long way behind come the Niagara Falls, 177 ft. high and 1,968 ft. wide. The third largest fall is that of Rhine at Schaffhausen, 140 ft. wide, by only 33 ft. high. The highest waterfalls mentioned cannot compare with those gigantic falls as regards cubic contents.

SMOKE-PREVENTING APPARATUS.

OUR illustration, borrowed from *La Nature*, shows a new device for removing one of the minor troubles of life. The chimneys of our rooms too frequently do not draw well, and in consequence there is smoke. If even a strong gleam of sunshine falls upon the outlet, or if there is a gusty wind or a heavy rain, the action of the flue is impeded. The smoke flows back, and often renders uninhabitable the room which we have been trying to warm. The usual remedy in such a case is to throw the door and windows wide open, and thus create a current of air which, for a time, re-establishes the draught. This simple and primitive measure is, however, not greatly to be recommended, as the remedy may easily prove worse than the disease.

Many devices have been proposed for overcoming the nuisance, such, for instance, as the fixed hoods which



serve for a defence against the sun and rain, and the screw aspirators which are sometimes used when there is a deficient height of chimney.

M. Becker, of Paris, has devised an apparatus which consists of an ordinary cowl, fitted at its windward end with a conical inlet-piece through which the wind passes in a jet into the interior of the hood. A draught is thus created in the flue, and its strength increases with that of the wind.

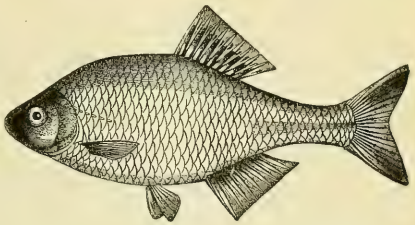
The action is similar to that of a Giffard injector, and the principle of aspiration thus produced by the wind is also applied in certain self-registering meteorological instruments, such as Bourdon's anemometer. The apparatus is applicable without any modification to the ventilation of drains.

It is doubtless true that this apparatus increases the chimney draught, and what is still more important, it prevents a down-draught, and so promotes a better combustion of the fuel, but it must not be supposed that the mere introduction of air into a cloud of smoke, as shown in the accompanying engraving, will cause the smoke to be consumed.

THE BITTERLING AND ITS EGGS.

THE bitterling (*Rhodeus amarus*) is a tiny fish, the smallest of the European carps. It occurs in the the rivers of France, Holland, and Germany. The male is remarkable for its brilliant and varied colouration during the spawning season; the female for a peculiar appendage, which projects from the under surface of the body, in front of the anal fin, and looks like a long orange-coloured worm Von Siebold found, many years ago, in the Strassburg fish-market, a female bitterling, in which this tube was distended by a number of eggs, which gave it a beaded appearance. After the spawning season is over, the tube shrinks, and becomes almost invisible.

The use of this singular appendage is known, but, it would seem, not very widely known. Seeley's "Freshwater Fishes of Europe," for example, a book which contains much useful information drawn from German sources, says (p. 209):—"No one has observed the mode of deposition of the eggs, or ascertained whether this remarkable tube, which is furnished with its own blood-vessels and nerves, is made use of to place the eggs in a secure position." In reality the problem had



BITTERLING (CARP).

been solved nearly twenty years before this passage was written, as may be seen by reference to Dr. F. C. Noll's papers in the *Zoologische Garten*, 1869 and 1877. The tube of the female Bitterling is an ovipositor, used for laying eggs in the gill-chamber of the river-mussel (*Unio pictorum*). In this situation complete protection from greedy fishes is obtained, while the water, which the mussel for its own purposes causes to stream incessantly over the gills, aerates at the same time the embryos of the bitterling. The same nursery is used for the hatching of the young of the mussel itself. Doubtless it would eject the embryo bitterlings if it could, but, having neither jaws nor limbs, it is powerless against the intruders.

Dr. Noll has been fortunate enough to observe the act of egg-laying in bitterlings kept in a small aquarium. In spring the fishes pair, and the male accompanies the female assiduously. The ovipositor of the female lengthens rapidly as the spawning time draws near, and the male puts on his gay colours. At length the female places herself, head downwards, close to the hinder end of the mussel, where the inhalent and exhalent apertures lie, and suddenly passes a large yellow egg into the gill-chamber of the mussel by means of the ovipositor. The male then fertilises the egg after the manner usual in fishes. Meanwhile the mussel becomes

uneasy, and buries itself in the mud or sand, as if it disliked the operation. But the mischief is now done, and the parasite has got a lodging within its host. Some weeks appear to be necessary for hatching the embryo. It is unlikely that the young bitterling preys upon or injures in any way the mussel which gives it shelter.

This curious history by no means rivals the strange modes of egg-laying already observed among insects, but it is singular among fishes, whose life-history contains, as a rule, so little romance. The nest-building sticklebacks and the siluroids, which hatch their eggs in the mouth of the male, are alone worthy to be mentioned side by side with the ingenious bitterling. It may further be remarked that the eggs are few and large, as in nearly all cases where something like parental care is shown.

SOME EFFECTS OF DIFFERENCE IN SIZE.

ENGINEERS have long been familiar with the fact that small objects are better able to support their own weight than large ones of the same materials and the same proportions. A card house may be built strong enough to bear its own weight and a great deal more, but multiplying all its dimensions by 100, and it will collapse by bending or crushing its sides. A large plank, supported only at the ends, will bend to a greater angle than a small one of precisely the same proportions. This principle is clearly seen in the skeletons of animals. The bones of small animals appear light and elegant in comparison with those of very large ones, when both are drawn to one scale, and yet they may be subjected without danger to very trying conditions. A dog's hind leg is ordinarily bent at considerable angles, so as to give the possibility of a sudden leap; the massive limbs of the elephant are only safe when the bones are pretty nearly in the direction of pressure. Strength increases as the square of any linear dimension, weight in the higher ratio of the cube.

In animals altogether similar except in size what is called the *relative muscular force* diminishes very fast as the size increases. For contractile force increases as the sectional area, *i.e.*, as the square of any linear dimension, while the weight increases as the cube. Many insects can raise (over a pulley) twenty times their own weight, but a horse can only raise a little more than half his own weight. Nevertheless, the contractile force of the muscles of the horse is, fibre for fibre, far greater than that of any insect. Plateau's experiments show that what he calls the *absolute muscular force* (contractile force per unit of sectional area) is very low in insects and very high in quadrupeds.

When the leaping powers of animals are compared, no allowance should be made for size. To bring out a result of any value, we ought simply to divide in each case the work done by the weight. For, in similar animals the work done in contraction is proportional to the volume of the muscles, and the volume of the muscles to the weight. But the work = weight raised × height, and the weight is in each case the weight of the animal itself. Therefore,

$$\frac{Wt \times Ht}{Wt} = \frac{Wt' \times Ht'}{Wt'}$$

The weights, in short, "go out," and $Ht = Ht'$, whenever equal efficiency in leaping exists, whatever be the scale of the creatures compared. Hence we may cease to wonder at such well-known cases as the flea, which leaps a foot high, *i.e.*, 200 times its own length. It has been observed* that this apparently stupendous feat indicates precisely as great efficiency of muscles or other leaping apparatus as would be implied in a man's leap to the same height, viz., one foot.

Large objects have the advantage of greater stability than small ones, *i.e.*, they can more easily resist overturning. The overturning forces, where for instance similar structures are exposed to wind of a given velocity, can be shown by very simple reasoning to vary as the cube of any linear dimension, whereas the resisting forces vary as the fourth power. Hence if one obelisk, pillar, chimney, or pinnacle be twice as great in every dimension as another, it will be able to resist twice as much pressure of wind per square foot, and the resistance to overturning will be sixteen times as great as in the smaller one.† A tall object may be built more slightly than a short one—where stability only, and not strength, has to be considered—of the very same external proportions. Again, a big tree may be equally firm with a relatively smaller extent of roots than a small tree. An ostrich can stand or run upon two relatively short toes, while a small bird requires three relatively long ones. For the very same reason, little pebbles are easily rolled along the bed of a stream, while large pebbles of similar proportions and of the very same substance stick fast. A yet more familiar, though not exactly comparable case, is that of stones in air. We know how the tiny particles of limestone or granite, rubbed off the road by horse-shoes and wheels, rise into the air with a light summer breeze, while, fortunately for us, the big lumps of the same kind lie still.

The further investigation of the subject involves considerations of a kind not yet familiar to general readers, but those who have patience to master what may be called the Mechanics of Size may be assured that these studies will give a new interest to many every-day facts, and clear up many long-recognised perplexities.

MICROBIOLOGY.

A DISCUSSION is now in progress between MM. Roux and Chamberland on the one hand, and M. Chauveau on the other, concerning the immunity which one attack of a zymotic disease confers against the subsequent return of the infection. M. Pasteur and his disciples contend that the micro-organism which occasions the disease perishes by exhausting, in the medium where it has been developed, all the elements essential to its life and multiplication. M. Chauveau, on the contrary, argues that the disease germ perishes by self-poisoning, *i.e.*, that it develops a soluble ferment in the presence of which it cannot exist. He advances as an argument that all lambs born of mothers which had been inoculated have proved non-susceptible even to the most virulent subsequent inoculations. But no microbion could have penetrated into their organisms, since the placenta is a filter which does not give passage to any figured ferments.

* Miall and Denny on "The Cockroach," p. 84.

† These results are worked out by Professor James Thomson, in his "Comparisons of Similar Structures." Tr. Eng. and Shipbuilders in Scotland, vol. xix., p. 69 (1875-6).

FEMALE BEAR BATHING ITS YOUNG.
(*For description see next page.*)

Natural History.

THE BLACK BEAR OF AMERICA.

Everyone must have had occasion to remark that many of the proverbial sayings applied to animals, whether wild or tame, are radically false. The alleged magnanimity of the lion must be largely discounted. It has been found that the hare is not more timorous than other beasts, though it does flee before a pack of hounds, or before marksmen carrying arms of precision. Far from being stupid, the goose surpasses a number of birds in intelligence, and in like manner Master Bruin, who has been taken for the very type of stupidity, possesses a fiendish cunning, an excellent memory, senses of an exquisite delicacy, and a mind susceptible of a certain degree of education. Still, we must admit that up to a certain point the bear is open to the charge of coarseness. When young he is, indeed, gay, sociable, and much attached to his associates, but with advancing age he grows dull and surly. In spite of the interesting relations which he maintains with the public in our Zoological gardens, he does not become humanised; he obeys his keeper grudgingly, and he bestows an evil reception upon any person who is imprudent enough to enter his den, or who is awkward enough to fall into it.

Brehm and other observers cite not a few instances of bears, captured young, brought up in domesticity, surrounded with attention,petted, in a word, like children of the family, which yet some fine day suddenly betrayed the confidence of their masters and gave themselves up to acts of violence even against those who had fed them. But do not the lions and the panthers of our menageries behave in an exactly similar manner? Do not all the larger cats, when tamed, retain the natural ferocity of their race, taking by opportunity a cruel vengeance for the restraint imposed upon them? Bears are therefore neither more brutal nor more ferocious than many other mammals. During the winter, when pressed by hunger, they become very dangerous, attacking not only the domestic animals, but even man. During the fine season they are content, for the most part, with vegetable food, honey, and ants, and let those pass in peace who do not seek to injure them.

In their woodland retreat bears pass entire hours in licking their paws, and in the dens in our Zoological gardens they preserve the same habit. But the expression "unlicked cub," sometimes bestowed upon a youth badly brought up, has another meaning.

It was formerly supposed that the cubs of the bear were born in a very imperfect condition, and were gradually licked into shape by the mother. Aristoteles describes the new-born cub as blind, hairless, having its limbs merely sketched, and being about the size of a rat. Pliny and Ovid express themselves in a very similar manner. This strange notion was handed down through the entire middle ages until its absurdity was recognised in the sixteenth century by Aldrovandi. Ultimately Buffon proved distinctly that young bears are born in a grade of development not relatively inferior to that of other mammalia, and that like the latter they merely present a certain deficiency of equilibrium in various members of their body.

Without being beautiful, young bears please the observer by their gaiety and grace. They love to frolic, and in their sports they evince the same fascinating awkwardness as do young children. The mother presides at their sports, and seeks to cultivate their dexterity. In her solicitude she often forgets even to eat, but her love never degenerates into weakness, and while she lavishes it upon her offspring, she does not spare correction if necessary. A box on the ear well applied represses any act of disobedience and maintains her authority. The Russians pretend, indeed, that in certain cases the mother keeps with her a son of the last season, or of the last but one, and commits to him the supervision of the young family, reserving the liberty of chastising him sharply for any neglect in the exercise of his duties. But not all bears indulge in the luxury of thus engaging a private tutor for their young ones. In fine weather they lead the young ones to the nearest pool and bathe them.

Our figure represents a mother thus engaged with the toilet of her family, holding in her mouth a cub all dripping with water, and apparently much discomposed at this forcible ablution. The actors in this scene are American bears belonging to a species which differs from the brown bear of Europe, both in its proportions, and in the colour of its fur. In this species, *Ursus Americanus*, the total length of the body (six feet six inches) is much the same as in the brown bear of Europe, *Ursus arctes*. The head is narrower and more resembles that of a dog, the ears are wider apart, the forehead more regularly convex, and the profile more regular without a marked depression below the eyes. The muzzle is more pointed, the body less massive, supported on limbs which are more slender. The tail is more distinct and less buried in the fur.

The fur itself, instead of presenting a woolly texture and a hirsute aspect, is generally in adult specimens formed of smooth, silky hair of a deep black. The muzzle alone is covered with short hair, of a brown verging on fawn colour, especially on the sides and in the vicinity of the eye. The feet, shorter than in the brown bear, are armed with very sharp recurved claws, partly hidden in the fur.

These characters are not so well marked in the cubs, which present a yellowish crescent on the chest, a mark which recurs in certain Asiatic bears.—*La Nature*.

Cormorant Fishing in Japan.—Mr. P. L. Youy (*American Naturalist*) gives an interesting account of the services of tame cormorants in fishing in the mountain streams of Japan. The fish most particularly sought for, the "Ai" of the Japanese, belongs to the Salmonidæ, and bears the scientific name *Plecoglossus altivelis*. It is in appearance between a trout and a smelt, from twelve to fourteen inches in length, of a bright silvery colour, with a golden spot on each shoulder. It is very delicate in flavour, and is prized accordingly. Fishing begins at night, preferably in calm, cloudy weather. The bird has a ring round the lower part of its neck, to which is attached a cord held by the fisherman, who carries a torch or lantern in his left hand. The bird dives, swims under water, and comes up with fishes, which are put in the basket. During half an hour fifteen fish were taken. A good night's take ranges from 300 to 400. The question may be raised whether it is not better thus to train the cormorant to fish than to shoot him down, as is the custom here?

The Crossing of Cultivated Plants.—According to the observations of Robbe, given in *Humboldt*, stock plants which have grown from energetically germinating

seeds (*i.e.*, such as germinated in three or four days) yielded chiefly, and in some cases exclusively, dark flowers; plants of the same kind from seeds which germinated slowly (in nine to eighteen days) produced single, but fruitful blossoms. In crossings between sorts of stocks which incline to yield double flowers, and such as bare chiefly single flowers, the properties of those kinds which had yielded the pollen predominated, not so much in colour, which was generally the mean between the parents, but in the general shape of the bunch of flowers and in the proportion of the double to the single flowers. Robbe infers that in a sample of seed the "germinating energy" should be taken into account as well as the mere "germinating capacity," as commonly determined by horticulturists."

THE ADHESION-ORGAN OF BATRACHIAN LARVÆ.—The larvæ of those batrachians which deposit their eggs in water have, on their under surface near the mouth, a clinging or adhesive organ, the varying forms of which are useful in distinguishing the species. After a week or a fortnight it disappears entirely, leaving not a trace behind. It is, according to Balfour, probably a rudiment of the same primitive organs as the sucking-disc of *Lepidosteus*. If we compare the forms of this organ we find that it makes its first appearance sometimes as a semi-lunar or V-shaped furrow, sometimes as two distinct prominences. In some cases it is single, and in others it consists of two symmetrical parts. The semi-lunar form (cephalic crescent of Van Bambeke) occurs in *Bufo, Discoglossus, Pelobates*, and *Pelodytes*, whilst the two prominences occur in *Rana agilis, Hyla*, and *Bombisator*. *Rana esculenta* and *R. fusca* form connecting links between these two groups.—(Dr. Thiele, in *Zeitschrift für Wissenschaft Zoologie*.)

A NEW DESTRUCTIVE INSECT.—According to Dr. L. Just (*Biedermann's Central Blatt*), the potato and tobacco crops in Baden have lately been attacked by the larvæ of an Elater *Corymbites æneus*. It resembles the ordinary wire-worm; it is of a yellowish colour, has a hard, tough skin, and reaches the length of one and a-half inches. It eats its way into the young tubers of the potato, so that they appear as if riddled with small shot, and attacks the stems of the potato plant in a similar manner, causing it to wither and perish. Tobacco and hop plants are injured in a similar manner.

STRUCTURE OF THE EYE IN A BRANCHIOMMA.—M. Brunotte (*Comptes Rendus*) concludes that the eye of Branchiomma must be regarded as a true compound eye, differing in structure from that of other Annelides. It has two layers, of which the more superficial forms the dioptric apparatus, whilst the deeper stratum gives rise to the sensitive elements.

DESTRUCTION OF WOLVES IN FRANCE.—According to *La Science en Famille*, these destructive animals, after so many centuries of civilisation, are not yet extirpated in France. In one year there have been killed—416 full-grown wolves, 328 cubs, and 16 pregnant she-wolves. The rewards for their destruction are 100 francs for each adult, 30 for each cub, and 150 for each pregnant she-wolf. It is suggested that the wolf-hunters spare young she-wolves in the prospect of earning a larger reward by killing them afterwards when pregnant, or when attended by a litter of cubs.

THE FASCINATION OF SERPENTS.

THIS question has given scope for no little superstition—we might almost say mythology—and also to sound zoological study. Like many other of the traditions of our fathers, this fascination must not be at once rejected as simple falsehood. Careful examination not only admits that, in common phrase, there is "something in it," but throws a light upon the *modus operandi*.

Some observations made by Herr Fischer-Sigwart, and described in *Humboldt*, will be found very valuable. On the 11th of September, 1881, this naturalist saw in his vivarium a water-snake (*Tropidonotus natrix*) pursuing a quail. The latter had been brought in alive by a setter the day before, and was, therefore, very unwell. It lay in a corner with head bent down and the eyes closed. A large hungry, common water-snake drew near in search of food, when the quail, opening its eyes, suddenly perceived the enemy, and in alarm strove to take flight. But this the bird was unable to do. In deadly fear it jumped up and down at the distance of half a yard before the snake, instead of flying away, keeping its head all the time turned towards the snake, and uttering an anxious piping. The snake remained quietly lying on the posterior two-thirds of its body, but with its raised head and neck it followed all the movements of the quail, keeping the eyes fixed upon it as it sprang to and fro. After a few moments the quail remained quiet, in a crouching position, with half-open wings, still gazing at the enemy and awaiting its fate. The snake began suddenly to move. It approached the victim, and was about to seize it with its jaws, when I interfered, which I have since often repented. The quail quickly recovered from its fright, and subsequently from its illness.

Since it has often been doubted whether the water-snake attacks birds, this incident in the vivarium seemed to the author worth recording. It is a proof that such an event may happen when a hungry snake, ranging about, comes so near as to be able to fix its gaze upon a bird, and to attract the eyes of the latter. It might be considered going too far to refer here to the old belief in the magical, fascinating power of the gaze of serpents. But Herr Fischer-Sigwart states that he has often watched, at a very short distance, the snakes in his vivarium seizing their prey, and he is convinced that these traditions are not totally unfounded. Frogs pursued by the water-snake soon lie flat down, turn towards their pursuer, and utter a lamentable cry which he has never heard from frogs, save when they found, or fancied themselves in the power of a serpent. Soon they become quite still, and allow themselves to be swallowed without resistance. Herr Fischer-Sigwart thinks that the process may be explained as follows:—The snake seeks first to get near its intended booty, and this, recognising its enemy, falls into panic and confusion, still making fruitless attempts at flight, and still looking at its pursuer. The snake turns now a steady gaze upon the victim, following all its movements with its head until the latter falls into a hypnotic condition, on which it is seized and swallowed. That when a serpent seizes any animal, panic plays the main part in the first place, and that the hypnotic condition only sets in afterwards, seems to appear from the fact that a frog, knowing that his deadly enemy the water-snake is near at hand, uttered the above-mentioned cry when a stick was

presented to him. This experiment has often succeeded in the author's vivarium, in which, in 1881, the frogs were exposed throughout the summer to the persecutions of a number of grass-snakes, to which they all ultimately fell victims.

We are here reminded of the phenomenon known as "shamming death," not unfrequently witnessed in many departments of the animal creation, and of the state of helpless panic into which horses and cats are thrown in case of a conflagration, so that instead of escaping through open gates, they sometimes rush headlong to destruction. We may also in this connection remember the superstition of the "evil eye," which still prevails in southern Europe, in the East, and in many parts of Asia and Africa.

In the Middle Ages a fixed gaze was accounted one of the many means by which the sorcerer could gaze a command over his destined victim. In witch-trials the judges were particularly cautioned to avoid catching the eyes of the accused.

It is well known that some years ago a series of experiments were performed in public upon human subjects under the painfully-absurd name of "electro-biology," which was afterwards shortened by certain quacks into "biology," and in that name—or rather nonsense—is still used in certain circles.

All these phenomena, and many more which we have not the space to enumerate, were referred, by our late friend, Dr. Beard, of New York, to trance, or to an approxmating condition, which he called the "tranciform state."

It must not, however, be supposed that all animals when pursued or threatened by serpents are in any way paralysed. When about eighteen years of age we had a vivarium in which specimens of nearly all European species of reptiles were confined. We have often seen how, when a live mouse or mole was thrown in, all the vipers were up in arms snapping at the warm-blooded intruder. But the mice, though they had often been caught in woods where vipers were far from rare, and might consequently be expected to know and fear them, did not appear stupefied or perplexed. On the contrary, they scampered about, seeking shelter among the stems of heath and *Ledum palustre* until the fatal bite was given.

Many death-snakes seem to lurk, quietly watching until some suitable booty passes within striking distance, when it is bitten before it can learn that an enemy is near.

THE TESTING OF ELECTRICAL APPARATUS.

UNDER the auspices of the directors of the Technological Museum at Vienna, a most useful laboratory has recently been opened for testing electrical appliances. The programme has just been issued, and from this it appears that the work will embrace experimental investigations of dynamos as regards output, power consumed, efficiency, and other matters. There will also be investigations and reports on completed installations for lighting, and power and photometric tests of arc and glow lamps, as well as the calibration of measuring instruments and the testing of primary and secondary batteries. The tariff fixed for the work is as follows:—For testing a dynamo, from £1 4s. to £4; a glow lamp, 16s. to £1 4s.; an arc lamp, £1 4s. to £1 12s. If the work is of a special nature, the charge is to be agreed upon beforehand.

In England, as in other countries, there are several good school laboratories, but none which are conducted by independent officials, and we trust that the above example will soon be followed in this country. Electricity now plays so important a part in our affairs, and as the varieties of apparatus are almost as numerous as the competing makers, it is no doubt time that a purchaser should have the means of ascertaining by independent testing what is the real efficiency of the apparatus he proposes to buy. There are too many *soi-disant* electricians, who talk very glibly of volts and amperes, and who make very startling statements about the output of their machines, or the lighting power or durability of their lamps, and the public should have the means of putting these statements to the test of practical trials, made by competent authorities. In the hands of certain well-known electrical firms, purchasers are no doubt perfectly safe, but even for these makers it would doubtless be an advantage to have their apparatus "Hall-marked," to prevent disputes arising with buyers. Inventors who have not the necessary laboratory appliances would also be greatly assisted if, for a moderate fee, they could have their inventions properly tested. Many mistakes and much needless expenditure of time and money would thus be avoided.

Experience has shown the great advantages to the public, as well as to the gas companies, of having all meters tested and certified by independent authorities, and it is well known that the Observatory testing of chronometers is good alike for the makers and the buyers.

We are aware that this subject has already been mooted in this country, and we trust that, in the interest of all parties, steps will soon be taken to establish a testing laboratory, to be managed by thoroughly competent and at the same time independent officials.

In Paris an electrical laboratory will be opened shortly. The buildings have been presented by the Brothers Menier, and various manufacturers have lent a steam engine, a gas engine, and electrical machines and apparatus. The laboratory is endowed with the profits of the Paris Electrical Exhibition of 1881, which amounted to £12,000. It is intended to give every facility to private individuals and manufacturers of electrical machinery for making researches which they could not carry on at their own laboratories or works. It is also proposed to standardise electrical measuring instruments, and to supply with each instrument which has been tested a certificate showing its limits of error; also to test electrical machinery generally, and to institute researches which the International Society of Electricians deem of sufficient general utility.

PYROGENIC MARBLITE.—Under this name a substance has recently been patented which is intended to supersede marble, where the latter is liable to become scratched or stained. The new substance is made in various thicknesses, is homogeneous, and usually has one side polished. It possesses a very durable polish, and, unlike marble, is non-porous, does not stain, and can be used where dampness would destroy marble. It is recommended primarily for shop-counters, tops of wash-stands, Turkish baths, and the like; but it would seem to be a very desirable material for the tops of lecture tables, and laboratory benches, where corrosive acids are in use, as these have no more action upon it than they have on glass bottles.

Reviews.

The Story of Creation. By Edward Clodd. London: Longmans, Green and Co. 1888. Price 6s.

The almost immeasurable modification in established conceptions—a modification little short of revolutionary—which has resulted from the general acceptance by scientific men of the hypothesis of evolution, and from their application of it to the study of all classes of phenomena, tends somewhat to blind the eyes of those who breathe the scientific atmosphere to the actual mental condition of many whose lives are passed outside it. It is very difficult for some of us to form any idea of a condition in these days which renders possible those crude conceptions of natural law which have been altogether discarded by the best thinkers of the new era. We forget the great difficulty with which changes penetrate beyond that stratum of plastic minds which is, so to say, always in a state of preparedness for improvement, always looking for light. We forget, too, that even where there is natural capacity and every willingness to accept an increase of knowledge, there is often so great a lack of previous training as to lead to a lack of power to appreciate the close reasoning, and the mass of evidence and technical detail, which are essential for the establishment of any new hypothesis as a doctrine of science. Until a new hypothesis has become a received doctrine, and has to some extent acquired what we may call a backing of authority, it is almost impossible to present it in a form likely to affect seriously the mode of thought of any but a select minority. On the whole it is quite as well that it is so; for the plastic minority alone is capable of both assimilating and discarding rapidly without danger to its stability. With the less easily modifiable majority, a change is a much more serious matter, being equally difficult to make and to unmake, and therefore we may rejoice that no transforming influence can in general be prematurely or hastily brought into action. But with regard to the hypothesis of evolution, we may safely say that it is high time some attempt should be made to present it in a form which may lead to its being "understanded of the people." Its powerful effect for good on our views of the world of matter—on biology, chemistry, geology, astronomy and, not least, on moral and social problems—justifies, if justification were needed, the demand that it should no longer be the exclusive property of the elect among thinkers. Men—men in general, not only men in particular—are growing to feel the need of a coherent system which shall explain for them, if not the inexplicable *Why*, yet something of the *How*. And for men in general, at least for those who will, in something like earnest, bend their minds to the subject, Mr. Clodd has condensed into some two hundred pages the Evolutionist's Story of Creation, of that gradual process of unfolding by which, out of glowing gas, there came to be the men who read and think of it. Mr. Clodd has brought to bear upon his task rare natural gifts of clear-thinking and lucid expression, and these, working upon a fund of knowledge have enabled him to produce a book which it is not too much to say may bring home to any ordinarily intelligent reader the meaning of the evolutionary hypothesis, and its application as a master-key to the secret workings of nature.

The book is not a mere exposition of Darwin's theory, for that dealt only with organic evolution, and in Mr. Clodd's own words, "Whatever lies within the phenomenal—the seen or felt—and therefore within the sphere of observation, experiment, and comparison . . . . . is subject-matter of inquiry." It gives, as far as may be in so small a space, a "general conspectus of evolution" in its widest range, including not only the evolution of inorganic matter, and of living things, but also the evolution of mind, of society, of language, art and science, of morals, and of theology. We have nothing but praise for the manner in which the difficulties inherent in such a task have been met and overcome, and we can hardly give more pointed expression to our feeling of approbation than by saying that in our opinion Mr. Clodd has done for the general public what Fiske did for the special public, when, in the two volumes of "Cosmic Philosophy," he gave the substance of the many volumes of that magnificent, yet almost inaccessible, exposition of evolutionary philosophy and science—the Synthetic Philosophy of Herbert Spencer.

The Farmers' Friends and Foes. By Theodore Wood, F.E.S. London: Swan Sonnenschein, Lowrey, and Co. Price 3s. 6d.

We have here a work which we may, without hesitation, pronounce interesting and instructive. The author proceeds on the lines laid down by Charles Waterton, protesting against the reckless and misguided slaughter of many creatures which are often harmless and even useful. So far we are heartily with him. But it seems to us that he overdoes his task. He under-values the good which man may hope to affect by a judicious interference with the fauna—the animal population—of any country, and he pleads for certain offenders with too much eagerness.

In the introductory chapter we find a view taken of the condition of men which we cannot entirely endorse. Says Mr. Wood: "There is no animal which he (man) can justly consider as a personal enemy." To this dictum we demur; the mosquitoes, the sand-flies, the chigoe, the land-leech, the screw-worm are as much enemies to the primitive savage as to the citizens of a civilised community.

Again, we read "that all injure us, and almost all benefit us by the character of their food." We may at once name the swallow tribe and the wagtails as species which do not injure us in the least. In the multitude which do not benefit us must rank all the parasitic species, all the blood-sucking flies, which not merely irritate and tease us, but introduce into our tissues the germs of zymotic disease.

Still, as regards a very large part—perhaps the bulk—of the animal kingdom, we have to balance the injury inflicted by any particular species against the benefits which it confers. Such utterances as the one here quoted from the chairman of one Agricultural Society, that "every bird that flies, and every creeper that crawls, endeavours to do the farmer mischief," is deplorable nonsense.

Mr. Wood's defence of the sparrow is, we think, scarcely judicious. A heavy charge against it, here overlooked, is its often successful war against the swallows and martins, our best gnat destroyers. We know instances where, in spite of every precaution, these useful and harmless birds have been entirely driven away by the sparrows.

In America, where the sparrow was introduced by a deplorable mistake, it has been found that they in like manner persecute and drive away birds which are much more efficient insect-destroyers than themselves. Num-

bers of sparrows have been shot, opened, and the contents of their crops carefully examined. On so doing, it has been found that the insects form but a small fraction in comparison with the vegetable matter. We should pronounce the sparrow as the only bird to be unsparingly destroyed, believing that whatever good he effects will be better executed by other hands—or rather, beaks—in his absence.

Mr. Wood writes truly enough, "We cannot obtain service in this world for nothing. Work brings wages as a natural corollary." But the more a bird is truly our friend, the less do his wages come out of our produce.

Among the farmers' foes rank, in the first place, certain rodents, such as the rats and the mice. The original home of the common rat seems to have been the region of the lower Volga, and it should hence be called the Russian rather than the Norwegian or the Hanoverian.

We are here told that rats might be "profitably employed for culinary purposes," as it is done by John Chinaman. Unfortunately these animals, however delicate may be their flesh, often swarm with trichinae and would hence, unless very thoroughly cooked prove a highly dangerous food.

The injurious character of the hare and the rabbit is duly enforced. It will be indeed weakness if in these days of agricultural depression Parliament grants a "close time" for such vermin.

We do not see that due attention is paid to the squirrel, which is, in fact, a tree-rat. It spoils in well-wooded districts no small quantity of pears, apples, and especially wall-fruit, not "taking a little," but gnawing off the sunny side of all they can find. Again, it rivals the cat and the weasel as an enemy of our small birds, which show evident alarm if they see one of these creatures. It devours the eggs and often the young also.

The hedgehog deserves a more laudatory notice than he here receives. He is the only European quadruped which can successfully engage the viper, and where he has been hunted down by the combined activity of game-keepers and gipsies—an unholy alliance—these snakes increase wonderfully. Nor must we forget that the hedgehog proves himself a "farmers' friend" by devouring slugs, snails, and the grubs of the cockchafer.

With the exception of the sparrow we entirely agree with Mr. Wood in his plea for the small birds, and quite as much, if not more, as regards the small birds of prey and, above all, the owls. Had we the power, we should visit the shooting or trapping of an owl, or the destruction of its nest, with a minimum penalty of £5—certainly not too high a figure in case of so useful a servant of the public.

Mr. Wood's work is rich in interesting observations, and will form pleasant reading for many persons who have no personal connection with the farm or the garden.

A Treatise on Photography. By Captain Abney. London: Longmans, Green and Co. Price 3s. 6d.

This book, which forms one of the "Text Books of Science" series, is now submitted to us as a fifth edition, revised and enlarged, so as to include the advance of photography up to the most recent date. The publishers were indeed fortunate in obtaining the co-operation of a scientific photographer of such eminence for the production of this volume. We should like to quote a sentence from the short preface by the author, as it emphasises a remark we made recently in reviewing a photographical hand-book, and as it can hardly be too strongly impressed on those who make photography a source of pleasure or profit. Captain Abney says, "It is a matter of regret to him that amongst photographers, both amateur and professional, there are but few who take what may be called a scientific interest in the art they practise, and it would be a source of gratification to him if this work should be the means of adding even a few earnest workers in the wide field which is still open for investigation." This sentence is the keynote of the whole book, and we have the why and wherefore of the numberless photographical processes described with a painstaking clearness that leaves nothing to be desired. In the space at our disposal, we cannot enter into details of Captain Abney's masterly treatment of his subject; it will be sufficient to mention that within the limits of this small volume, we have descriptions of nearly every known photographical process from the year 1777 to the present time; concise, of necessity, but never superficial, where information can be of use to the student; and we think many photographers will date their "scientific interest" in photography from their study of Captain Abney's book, and so fulfil his earnest wish as quoted above.

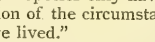
A Manual of Orchidaceous Plants cultivated under Glass in Great Britain. Part I., Odontoglossum; Part II., Cattleya and Laelia. James Veitch and Sons, Royal Exotic Nursery, King's Road, Chelsea.

This elaborate work may be considered as addressed to the horticulturist rather than to the botanist. Still it is impossible for the orchid family to be fairly discussed without raising questions in which the student of plant-life will be profoundly interested. In fact, no great group of plants can be considered more instructive, and much as has been done by Darwin and Müller, very much still remains to be ascertained. One of the most obvious lessons here brought to the front is the light which the orchids throw on the supposed fixity of species. In them we recognise hybridity occurring naturally—that is, without human intervention. These hybrids, further, are by no means barren, but are perfectly capable of reproduction. We feel confident that if any competent and conscientious naturalist, if such still exist, who holds to the doctrine of the permanence of species would undertake the study of this one family he would find himself driven to accept the great principle of Evolution.

We note with pleasure that the authors quote Lamarck's definition of species, which we here reproduce:—

"A collection of similar individuals which were produced by other and similar individuals constitute species. This definition is exact, for every living creature *nearly* resembles those which produce it. That the species is constant is not true; it is not distinguishable by invariable characters. Species only have a constancy relational to the duration of the circumstances under which the individuals have lived."

Each of these parts is illustrated with maps showing the localities of the forms described, and with carefully-drawn figures of the plants themselves and of the flowers.



BLUE MARKING INK.—Mix a sufficient quantity of ultramarine with barytes (sulphate of barium, blanc fix) and water to produce the desired tint. It may be rendered more permanent by adding some liquid glue (solution of glue in acetic acid) or some starch paste, prepared with the addition of a little wax.—*Chemist and Druggist.*

Abstracts of Papers, Lectures, etc.

LONDON INSTITUTION.

On the 2nd inst. Mr. Robert H. Scott, delivered a lecture on "British and Atlantic Weather." After some preliminary remarks he said that, "Over the Atlantic Ocean atmospheric pressure was intimately related to temperature, while the direction of the wind is subject to a deviating force depending upon the latitude, the earth's rotation causing a deflection of the air currents, while the difference between the heating of land and water produces a real difference of pressure. Taking two mountain stations of about equal height, 14,000 ft. Antisana near the Equator, and Pike's Peak in latitude 39 deg. N., it was shown by the barometer at the top and at sea level how the lower atmosphere moves towards the Equator, and at high elevations away from it. The winds of the Atlantic and neighbouring countries are influenced by the permanent area of high barometer readings existing on the northern edge of the tropics, being northerly and north-easterly from the coast of Portugal southwards, easterly in the tropics, south-easterly and southerly by Florida and the American coast, and westerly north of latitude 40 deg. N. In the tropics the weather is pretty constant, but the trade region is not a rainless district as many suppose, a great deal of rain falling in the belt of calms, which is the birth-place of West India hurricanes. These travel to the westward as far as the West Indies, then curve to north-west, north, and north-east round the edge of the permanent anticyclone. In all oceans, both north and south of the Equator, the movement of cyclones is similar, towards the west in the tropics, then curving to higher latitudes, and finally moving to the eastward. On the ground of expense it is impossible for us to know the conditions existing off our western coasts; the suggestion having been made, and a question asked Parliament last session, it has been ascertained that the initial cost of laying a buoy at its end 500 miles west of the Irish coast would be £60,000. This precludes the possibility of making the attempt, a trial some years ago with a ship moored in seventy fathoms having proved a failure. Various countries have from time to time undertaken the discussion of the weather of the Atlantic, but the most important was that taken in hand by our own Meteorological office for every day during the thirteen months from August, 1882, to August, 1883, corresponding with the months during which an international series of scientific observations were being made in the Polar regions. By this means the charts have been rendered more complete than was possible otherwise, while the appeal of the meteorological council to English and foreign merchant captains resulted in an average of 400 observations a day over the sea, the number of land stations on both sides of the ocean reaching a considerably higher total, so that this great work has been based upon about 1,000 observations a day, probably ten times as many as had ever been used in previous works of the same nature, and yet, from the experience gained, this mass of data is now considered too small to follow all the variations which are constantly in progress. Entering into details of the storms shown on the charts, the neighbourhoods of greatest storm frequency are found over Nova Scotia, a little further north in mid-Atlantic, between Iceland and Greenland, and in Davis Strait, with regions of less frequency to the south-west of the British Isles, and one or two other localities. Many storms originate as far west as the Rocky Mountains, if not over the Pacific Ocean, Mr. Harris having traced one from the Philippine Islands and the Pacific and America to Europe, taking a little over a month to do the journey. Some of the cyclonic systems from the Rockies travel by the American lakes and curve to the north towards Davis Strait, where they remain several days; some cross Greenland to Iceland, and perhaps visit us. Many systems appear to become almost stationary, oscillating backward and forward for days. Instances are very common of the coalescing of two storm areas, and the breaking up of one area into two parts, each distinct from the other. It was shown that it is not necessary for us to have a storm centre pass over us to account for a gale, as the centres are often hundreds of miles out at sea, but the high and increasing barometer over Germany and Russia causing steepness of the gradient, brings stormy weather to our coasts. For some time past the United States Weather Department has been sending daily information of the conditions over America and any reports made by ships of disturbed weather on the western side of the ocean. The results so far have been small, Mr. Scott, thinking that the ship reports are not full enough.

GEOLOGICAL SOCIETY OF LONDON.

At the meeting held on February 8, 1888, Prof. J. W. Judd, F.R.S., President, in the chair, the following communications were read:—

"On some Remains of *Squatina Cranei*, sp. nov., and the Mandible of *Belonostomus cinctus*, from the Chalk of Sussex, preserved in the Collection of Henry Willett, Esq., F.G.S., Brighton Museum." By A. Smith Woodward, Esq., F.G.S.

The remains referable to *squatina* consist of a crushed skull, with the mandibular and hyoid arches, and an associated fragment of the pectoral fin with dermal tubercles. The fish was probably about 30 inches long. The form and relative proportions of the cranium, etc., appear to be similar to those of the living representative of the genus. The dentition is not completely preserved; the teeth near the symphysis of the mandible are relatively high and slender, while the opposing teeth are small. The great relative size of the spinous dermal tubercles serves to distinguish it from species of *squatina* already known.

No specimen of *belonostomus* has hitherto revealed the precise characters of the dentition or the relations of the hindermost bones. This deficiency is now supplied. The two rami occupy only one half the entire length of the jaw, the anterior half being formed by the elongated presymphysial bone, which is provided with a powerful prehensile dentition. The large median teeth end abruptly at the posterior extremity of the presymphysial element, but the small lateral teeth are continued backwards upon the rami of the jaw, increasing in size and becoming relatively shorter.

2. "On the History and Characters of the Genus *Septastræa*, D'Orbigny (1849), and the Identity of its Type Species with that of *Glyphastræa*, Duncan (1887)." By George Jennings Hinde, Ph.D., F.G.S.

In the type form of *Septastræa*, now in the British Natural History Museum, the walls of the corallites, though closely opposed, are quite distinct; the theca is formed by the extension of the septal laminæ; the walls

and septa in the lower portion of the corallites are very thin, but the upper portion of the corallites are so infilled with compact stereoplasm that the calices are extremely shallow when mature. There is no true columella, only a pseudo-columella, formed by the union and partial involution of the inner septal margins. The increase is exclusively by marginal gemmation; fission does not occur. In some cases linear perforations between the septa are shown; these appear to be for the insertion of the mesenterial muscles.

The septa in *Septastræa* consist of a central layer, dark in microscopic sections, enclosed on both sides by layers of compact subcrystalline stereoplasm.

There is a close correspondence in the septal and thecal structure of *Septastræa* to that of the recent and fossil genus *Flabellum*, and in this genus also the septa occasionally split longitudinally and show the same growth-lines on their median faces.

Only two species are included in *Septastræa*, as now defined, viz., *S. Forbesi*, Edwards and Haime, and *S. (Columnaria?) sexradiata*, Lonsdale, sp.

3. "On the Examination of Insoluble Residues obtained from the Carboniferous Limestone at Clifton." By E. Wethered, Esq., F.G.S.

The limestone-forming organisms in each of the carboniferous limestones at Clifton were mentioned, and the methods adopted for obtaining the insoluble residues by means of hydrochloric acid were described.

Detrital quartz of small size, with a few grains of felspar, tourmaline, and zircon, characterise the Lower Lime stone Shales, and in one variety the soft tissues of organisms are represented by ferric oxide, which in the case of crinoids represents the whole skeleton. Residues of the Black Rock exhibit slight secondary crystallisation round detrital quartz, whilst amorphous and chalcedonic silica become more plentiful. Residues of the Middle Limestone consist to a less extent of detrital quartz along with micro-crystals of quartz, amorphous and chalcedonic silica, and less frequently of pyrites, tourmaline, and zircon; sponge-spicules are also noted. Towards the top of the Middle Limestones the proportion of detrital quartz increases, and the deposit of secondary silica on the surface of quartz grains is less marked.

ROYAL METEOROLOGICAL SOCIETY.

At the monthly meeting, held on the 15th ult., the following papers were read:—

1. "Electrical and Meteorological Observations on the Peak of Teneriffe," by the Hon. Ralph Abercromby, F.R. Met. Soc. The author made a trip to the island of Teneriffe in October, 1887, for the purpose of making some electrical meteorological observations, and now gives some of the results which he obtained, which may be summarised as follows:—The electrical condition of the Peak of Teneriffe was found to be the same as in every other part of the world. The potential was moderately positive from 100 to 150 volts, at 5 ft. 5 in. from the ground, even at considerable altitudes; but the tension rose to 549 volts on the summit of the Peak, 12,200 ft., and to 247 volts on the top of the rock of Gayga, 7,100 ft. A large number of halos were seen associated with local showers and cloud masses. The necessary ice-dust appeared to be formed by rising currents. The shadow of the Peak was seen projected against the sky at sunset. The idea of a south-west current flowing directly over the North-east trade was found to be erroneous. There was always a regular vertical succession of air currents in intermediate directions at different levels from the surface upwards, so that the air was always circulating on a complicated screw system.

2. "Rainfalls of South Africa, 1842-1886," by Mr. W. B. Tripp. The author gives the rainfall statistics from all those stations situated in South Africa which possess records of ten complete years and upwards. He remarks upon the chronological succession of wet and dry years, and the consecutive years above and below the mean; and also describes the seasonal distribution of monthly maxima, and the extent over which monthly rains prevail. He concludes by comparing the curves of rainfall with those of sunspot energy.

3. "Some Methods of Cloud Measurements," by Mr. Nils Ekholm. As exact cloud measurements afford almost the only easily available means of determining motions in the upper regions of the atmosphere, the author describes some methods which seem to him likely to give the best results. He also details the plans adopted at the Swedish Polar Station, Cap Thorsaen, in Spitzbergen, and at the Upsala Observatory, for determining the direction and angular velocity of the clouds, and for making direct measurements of the height and absolute motions of the clouds.

SOCIETY OF ARTS.

At the meeting on the 8th ult. Mr. W. Lant Carpenter read a paper on the "Continuation of Elementary Education." He drew attention to the fact that the school life of many working men's children comes to an end at 12 years of age, and that they then obtain their amusements and pleasures from the streets, quickly forgetting what they have learnt. He also pointed out that the proportion of those over 14 attending school diminished from 1·14 per cent. in 1880 to 0·89 per cent. in 1886.

In Switzerland, the author said, attendance at apprenticeship school for two hours on five days a week was compulsory until the age of 16, and if the pupil failed to pass his examinations he was liable to be detained at school until 20. In Austria, Germany, and Hungary, attendance at continuation schools was compulsory.

In England the night schools simply educated those who by the accident of circumstances had been passed over by day, but in the last seven years the proportion of night pupils in attendance to that of the day scholars had diminished from 1·62 per cent. in 1880 to 0·76 per cent. in 1886.

The author then said that to remedy this defect in our educational system the Recreative Evening Schools Association has been formed for the purpose of promoting continuation classes in Board and voluntary schools, and the Association has been so successful that classes have been established in 92 out of the 128 schools belonging to the London School Board, and in 10 voluntary schools.

In conclusion he pointed out the alterations which, in the opinion of those who have studied the subject, should be made in the existing law. They are:—

1. The standard of age for total exemption to be 13.

2. The standard of qualification to be, for the present, the sixth.

3. That there be two evening school schedules (*a*) for those under Standard VI., (*b*) for those above Standard VI.;

and that in this last, three "specific" subjects take the place of the "three R's" as compulsory subjects.

4. That in both schedules, musical drill or calisthenics, singing, art hand-work for boys and girls, and cottage needlework for girls be extras, for which half the present grant be allowed, viz., 1s. 6d. Also that cookery be allowed as an extra, and that 6d. or 1s. be allowed to schools for the use of lanterns, objects, experiments, and applied teaching generally.

THE ROYAL SOCIETY OF EDINBURGH.

At the meeting held on the 6th ult., Sir William Thomson, president, in the chair, Professor Crum Brown exhibited an apparatus designed to show the action of the semi-circular canals. The apparatus consists of a rotary frame mounted on a platform. Two wheels, turning upon axes parallel to the frame, and moving, the one in a positive and the other in a negative direction, represented the canals. Each of the wheels was supplied with a stopcock on its axle. A supply of gas was led into the axles. The platform being rotated, the action of the wheels represented the action of the semi-circular canals, and the effect was made visible in the action of the gas.

Mr. John Murray submitted a series of observations on the temperature and currents in the lochs of the west of Scotland as affected by winds. The investigations were made within the last nine months. Mr. Murray stated that in one loch he found, within two days, a difference of something like 16 degrees of temperature, owing entirely to the effect of the wind. In Loch Fyne, on a day in January, when the wind was blowing across the loch, the temperature was at one place 48 degrees, and three miles further off, towards Inveraray, the temperature at the surface was 43 degrees. The conclusions of many observations was that there were large oceanic phenomena which could be explained by the action of the winds on the waves and water. One action of the wind was to bring the warm water towards the surface.

Mr. John Aitken explained a series of experiments for counting the dust particles in the atmosphere. He found 521,000 dust particles in a cubic inch. This is in what the author termed "clean" air, the experiment being made after a rainy night. In a room matters were worse, for there it was found that there are 1,860,000 dust particles per cubic centimetre, or 30,000,000 per cubic inch.

Dr. Milne communicated a paper by Mr. W. G. Reid on the solution of carbonate of lime in sea water under pressure. The author finds that the chemical activity of carbonate of lime is greater at a depth than on the surface of the ocean.

Mr. John Murray read a paper on the distribution of carbonate of lime on the floor and in the waters of the ocean.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting on Tuesday, the 7th of February, the president, Mr. Bruce, being in the chair, the paper read was on "The Alexandra Dock, Hull," by Mr. A. C. Hurtzig, M. Inst. C.E.

The Alexandra Dock was commenced on the 15th of January, 1881, and was completed and opened for traffic on the 16th of July, 1885, and during this period the works were for five months practically stopped. The dock was essentially a foreshore dock, some four-fifths of the site being below the high-water mark of the Humber, and a considerable portion below the low-water mark, the range of tides at springs being 22½ feet. The works included a dock of 46½ acres with two miles of dock-walls from 52 to 62 feet in height, two large graving-docks, a lock 550 feet long by 85 feet wide, a river embankment 40 feet high and 6,000 feet long, the dredging of an artificial channel through the Hebbles Shoal, erecting pumping machinery, the construction of sheds, and various minor works. Great difficulties were experienced in the course of the construction, owing to water breaking in through the clay foundations. The methods employed to overcome these interruptions are, however, too technical for description in our columns.

EDINBURGH BOTANICAL SOCIETY.

At the meeting held on the 18th ult., a paper "On the Fruits of the genus *Anemone*," by Prof. Edward Janczeroski, Cracow, was read by the secretary, Dr. M'Farlane, as was also "Notes on *Junas Alpinus*, with an exhibition of specimens," by Dr. Buchanan White. Mr. S. Grieve, on behalf of Mr. A. Bennett, read a paper on "Additions to the Scottish Flora during 1887, with a *resume* of the year's work." Mr. P. Geddes read a paper "On the Origin of Evergreens."

LIVERPOOL GEOLOGICAL ASSOCIATION.

At the monthly meeting of this association, held on the 6th ult., Mr. Charles Potter read a paper entitled, "Notes on some points in local geology." In it the author referred to various ideas that had been and were entertained as to the configuration of the Mersey estuary in past times, showing how impossible of acceptance were the theories that the Mersey had discharged its waters into the sea by any other channel than the present one since the deposition of the boulder clay. No traces of any other post glacial channel had ever been found in Wirral, and it was not unreasonable to suppose that had such ever existed, it would long since have been discovered. Certainly the route lately proposed for the Mersey, by way of the Great Float and Leasowe, seemed equally impracticable with others that had been proposed. The series of deposits on either side of Leasowe, on the Cheshire shore, were practically continuous, and showed no signs of having been deeply cut into by the waters of a great river.

GLASGOW PHILOSOPHICAL SOCIETY.

At the meeting held on the 8th ult., Prof. M'Kendric exhibited and described (1) E. von Fleischel's spectro-polarimeter, for the estimation of grape sugar; (2) a gas pump for the removal of gases from the blood; (3) a centrifugal apparatus for the separation of the red blood corpuscles; and (4) Kronecker's electro-myographion, for the study of muscular contraction. Sir William Thomson exhibited and described a new composite electric current balance. The peculiarities of this balance are that it combines in one instrument the means of measuring small currents or potentials (a Volt meter) the rate of working in an electric circuit (a Watt meter), and strong currents, say from half an ampere to five hundred amperes. For the measurement of strong currents a constant current of a tenth to half an ampere is kept flowing through the coils fixed to the beam of the

balance. The current to be measured is then made to flow through two fixed coils placed either both under the movable coils or one above and the other below one of the movable coils. The indications of the instrument are then in simple proportion to the current, and hence a long range is obtained in one instrument.

LONDON MATHEMATICAL SOCIETY.

At the meeting held on Thursday, the 9th ult., Sir J. Cockle, F.R.S., President, in the chair, the following communications were made: "Further Remarks on the Theory of Distributions," Capt. P. A. Macmahon, R.A.; "The Free and Forced Vibrations of an Elastic Spherical Shell containing a given mass of Liquid," A. E. H. Love; "On the Volume generated by a Congruency of Lines," R. A. Roberts; "Isoscelians," R. Tucker.

SOCIETY OF CHEMICAL INDUSTRY.

At the meeting of the Scottish section, held in Edinburgh, on the 7th ult., Professor Crum Brown in the chair, Mr W. Ivison Macadam, read a paper on "Manures, Natural and Artificial." Commencing with some remarks on natural manures, he passed to guanos and bones, mineral phosphates, methods of grinding and composition, dissolved manures and the machinery therefor, and the sources of ammoniacal materials, winding up with a reference to trade marks and the valuation of manures. Papers were also submitted by Mr. John Thomson on "A new Antiseptic Soap," and by Mr. J. Napier Spence on "The Estimation of Starch."

GEOLOGISTS' ASSOCIATION.

At the meeting held on the 3rd ult., Mr. W. Topley read a paper on "The History and Work of the International Geological Congress." It was to meet in London this year for the first time, from Monday, September 17, to Saturday 22nd, 1888. The congress originated in 1876 at the Buffalo meeting of the American Association for the Advancement of Science, which, meeting as it did very near the Dominion, partook very much of an international character. Professor Huxley, the honorary president of this year's congress, was present on that occasion. Three meetings had since been held. In 1878 the congress was held in Paris, and at its meetings 194 French members were present, and 110 of other countries, making a total of 304, the number of countries represented being 21. In 1881 it took place at Bologna, 149 Italian members being present, and 75 representatives of other countries, numbering 17. The total of members was 224. At Berlin in 1885, 163 German members attended, and 92 foreign members from 18 different countries, the total being 225. Many questions of importance and of general interest would be discussed at the London meeting, but perhaps one of its most valuable features would be the opportunity afforded for personal communication with geologists of eminence from all parts of the world. As the congress met only once in three years a considerable time must elapse before it could again assemble in England. During the week following the congress excursions would be arranged. The executive committees of the three preceding meetings, held in continental cities, received assistance from their Governments, from the State railways, and from other official sources not available in England. The expenses in this country must be met by private contributions. The committee would spare no pains in order to make this meeting of the congress a success, and it appealed with confidence for support and co-operation to all interested with the study of geology and the allied sciences. The officers of the congress were Professor J. Prestwich, president; the President of the Geological Society, the Director General of the Geological Survey, and Professor T. M. K. Hughes, vice-presidents; Mr. F. W. Rudler, treasurer; and Mr. J. W. Halke, and Mr. W. Topley, general secretaries.

ROYAL HORTICULTURAL SOCIETY.

At the meeting of the Scientific Committee of the Royal Horticultural Society on the 10th ult., Mr. Plowright, in a communication, remarked that "the extreme tip of the branches of the silver fir are often found bare of leaves and variously swollen and distorted. This condition has been assumed to be the result of injury from their having been bitten off by squirrels or other animals. In the specimens exhibited the mischief was caused, not by animals, but by a fungus, the so-called *Peridermium columnare*. Robert Hartig worked out the life history of this fungus in 1880."

Prof. Church called attention to the fact that though large percentages of aluminium are well known to exist in Lycopodiaceæ, it was not hitherto suspected to be general in flowering plants. A Japanese chemist having discovered it in *Rhus vernix*, etc., and in the gum of the lacquer resin, Prof. Church examined cherry-tree gums, gums arabic, tragacanth, etc., and found traces to be invariably present. In the *Analyst* for January it is stated that it is also invariably present in the gluten of wheat, in this case as a phosphate of alumina.

ENTOMOLOGICAL SOCIETY.

At the meeting held on February 1, 1888, Dr. David Sharp, F.Z.S., President, in the chair,

Dr. Sharp exhibited some insects forwarded to him by Mr. Kidston, of Stirling, collected by Mr. Alexander Carson on Kavalla, an island in Lake Tanganyika. The Coleoptera were nearly all well-known species, exemplifying the fact that many of the commoner insects of tropical Africa have wide distribution, some of these species being common both to Natal and Senegal.

Mons. A. Wailly exhibited and read notes on a number of cocoons of *Antheræa assamensis*, *A. roylei*, *Actias selene*, *Attacus ricini*, etc., lately received from Assam; also a number of nests of cocoons of *Bombyx rhadama*,—the silk of which is used by the Hovas in the manufacture of their stuffs called "Lambas,"—from the island of St. Mary, Madagascar. A remarkable feature of these nests is that the silk forming the outer covering is of a dark buff colour while the cocoons enclosed in it are quite white.

Captain H. J. Elwes read a paper on "The Butterflies of Sikkim," the result of many years of collecting in that wonderfully rich district of the Himalayas. He stated the number of species occurring in this small district to be about 530, which is greater than the number hitherto found in any locality in the more western parts of the Old World. An important feature in this paper was the numerous observations taken on the habits, variation, seasons of appearance, and range of altitude at which the various species occur, for which Captain Elwes said he was largely indebted to Herr Otto Möller, of Darjeeling.

JUNIOR ENGINEERING SOCIETY.

On the 3rd inst. a paper was read before this Society on "Some Novel Mechanisms" by Mr. W. J. Tennant, who pointed out that the most curious and complex forms of mechanisms were but combinations of the simple mechanical powers. As an example of the lever the oar was mentioned, and the controversy as to the correct position of its fulcrum was alluded to. In reference to novel gearing, Watt's sun and planet and annular motions were described, as was also Ferguson's paradox, and Heinrich's improvement upon it. General Cameron's device for transmitting motion by shafts whose axes are at an angle with each other without varying the angular velocity of the driven shaft was explained. The paper concluded with an extended description of Professor Hele Shaw's sphere and roller mechanism for varying velocity ratio without introducing sliding friction.

LIVERPOOL MICROSCOPICAL SOCIETY.

At the meeting held on the 3rd February, Mr. A. Norman Tate, F.I.C., F.C.S., in the chair, Dr. Frederick C. Larkin read a paper "On Making Permanent Microscopical Specimens of Blood," in which he described in detail the methods most suitable for mounting specimens of the blood of different animals. Mr. Willoughby Gardner then read a paper on "Wing Scales of Butterflies," in which he described the many beautiful forms and colours of the scales, and the usual modes of arrangement.

LIVERPOOL BIOLOGICAL SOCIETY.

At the meeting held on the 11th inst., the first part of an elaborate paper upon the minute anatomy of limax, the common slug, was brought before the meeting by Dr. R. Hanitsch. This was followed by a short paper on "The Alternation of Generations and Specific Nomenclature in Salpa and other Animals," by Professor Herdman, D.Sc.

THE VICTORIA INSTITUTE.

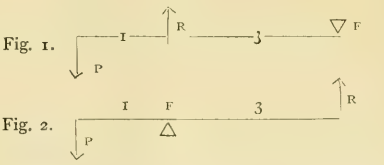
At a meeting held on the 6th inst., a paper upon the "Order of Creation" was read by Professor Warring, of Ploughkeepsie, in which he reviewed recent scientific statements, and compared the results of the investigations of Sir W. Dawson, Professors Dana, Huxley, Asa Grey, Agassiz, and others.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

WHAT KIND OF LEVER IS AN OAR?

I have been accustomed to consider that the action of an oar in a boat is in accordance with a lever of the second kind, that is, where the fulcrum is at one end, the power at the other, and the resistance between the two. The text-books on mechanics point out that the fulcrum is in the water, and the resistance acts at the rowlock. Now in reading a paper in the *Philosophical Magazine* (January, 1887), I was astonished to see that the writer of the paper—the Rev. T. K. Abbott—makes the true fulcrum to be at the rowlock, and that the oar belongs to the levers of the first class. He considers that, according to the orthodox theory, it would follow that the power would have the advantage over the resistance in the proportion of about 4 to 3 (this being usually about the proportion of the whole length of the oar to the part outside of the rowlock), and that if the rower's hand is moved nearer to the rowlock the mechanical advantage would be slightly diminished. Now if the oar were a lever of the first kind, the second conclusion would be still true, but there would be a mechanical disadvantage of 1 to 3 in using the oar, in point of power to be compensated for by some gain in speed.



According to our text-books, Fig. 1 represents the action of the oar; and, according to Mr. Abbott, fig. 2 represents this action. Of course he must assume as I assume, that the boat is to be moved by two oars on which equal pulls are executed, and which are perfectly symmetrical on both sides. Let P be the half pull of the rower or rowers, R the semi-resistance of the water to the motion of the boat, or the semi-reaction between the oar and the boat at the rowlock. The oar at F (its blade) is pressed against the water by the rower, and as action and reaction are equal and opposite, the water makes a corresponding resistance to the blade; at each blade let this semi-resistance be called S. Then in Fig. 1 $P \times 4 = R \times 3$, and $R = P + S \therefore S = \frac{1}{3} P$. If, according to Mr. Abbott, what I call S he assumes to be the semi-resistance of the water to the motion of the boat, then $P \times 1 = S \times 3$, and $S = \frac{1}{3} P$. But if with him as with me, R is the semi-resistance of the water, then $P \times 1 = R \times 3$, and $R = \frac{1}{3} P$, whereas with me $R = \frac{4}{3} P$. He does not make it clearer by stating:—"Suppose the rower to be in the boat as usual, but the boat to be fixed, while the oar presses against another boat which is free to move. In this case the oar is manifestly a lever of the first order; but the relative position and action of the oar, the power, and the resistance are in every respect precisely the same as in ordinary rowing." Because in this case the rowlock would undoubtedly be the *fixed* fulcrum, the hand the moving power at one end of the lever, and the other boat the movable resistance at the other end. That, however, alters the whole question. It changes the lever from one of the second kind to the first, the power is exercised to move *another* boat in the opposite direction of the hand. Now as it is a very important difference to say with the common theory that (in the case specified) the power exerted is $\frac{3}{4}$ of the resistance, and with this new theory that the power exerted must be three times the resistance, I would like to know the opinion of any of your readers on the subject.—Athletic.

QUESTIONS IN ASTRONOMY.

Will you or any of your astronomical readers give me the mean time of full moon on the 28th January, and the mean anomalies of the sun and moon, according to the lunar tables used by astronomers of the present day; and also the sun's mean distance from the Node. I only possess Ferguson's tables, which come down no lower than 1800; and I do not know whose tables are now used, but desire to test my calculations of the eclipse. J. de D.

THE COLOURATION OF BUTTERFLIES.

Is the following, which I quote from a back number of the *Revue Scientifique* correct?:—"Mr. Nicholas Wagner, using an exceedingly sensitive galvanometer, has discovered fixed currents in the wings of butterflies, and with the aid of electric currents has succeeded in producing changes in the nature and arrangement of pigments." A Colourist.

TECHNICAL EDUCATION NOTES.

National Association for the Promotion of Technical Education.—The Executive Committee of the North of England Branch of this Association have passed the following resolutions:—

1. That public funds (rates and taxes) should not be employed to meet the current expenses of teaching specific trades.

2. That it is undesirable that instruction in the use of tools should be introduced into primary schools as a grant-earning subject.

3. That with a view to preparing pupils for technical education later on—

(a) The grant to day-schools should depend, to a much less extent than at present, on the results of the examination of individual pupils in reading, writing, and arithmetic, and should be largely dependent on the inspector's report of the general character of the teaching and of the equipment of the school.

(b) There should be greater liberty in the choice of subjects in primary schools, and the same class subject should not necessarily be taken throughout the school.

(c) The grant to evening continuation schools should be regulated by the report of the inspector on the character of the teaching, and on the attendance list, and not upon the result of the examination of individual pupils.

4. That when a technical school is combined with a science and art school, the contribution to the building fund, through the Science and Art Department, should exceed £1,000 if, in the opinion of the Department, the requirements of the locality demand it.

5. That it is desirable that, when specific trades are taught in technical schools, the practical teaching of each trade should be under the general direction of a committee, consisting mainly of members of that trade; that the teaching should be given in the evening, and be restricted to pupils actually engaged in the respective trades, and that, when specific trades are taught, any deficiency in current expenses should be guaranteed by the trade of the district.

6. That a certain percentage of persons preparing for appointments as teachers in elementary schools should be allowed to attend lectures and laboratory work at Universities and University Colleges, where a curriculum satisfactory to the Education Department is provided, and that the same grant should be made on account of such students as in the case of ordinary training Colleges.

7. That it is desirable that University Colleges in which higher scientific and technological training are combined should be assisted by a Government grant, provided that evening instruction is given in all the subjects taught, at fees which shall bring the advantages of the College within the reach of all classes. The due administration of the grant should be secured by the appointment of certain nominees of the Government on the Executive Council of the College.

Students in Germany.—The number of students inscribed in the various German universities this winter is 26,945. At Berlin there are 5,478; Munich, 3,414; Leipzig, 3,288; Halle, 1,501; Breslau, 1,314; Tübingen, 1,254; Bonn, 1,119; Greifswald, 1,141; Gœttingen, 1,027; Strasburg, 886; Friburg, 884; Erlangen, 879; Heidelburg, 832; Marburg, 863; Konigsberg, 807; Giessen, 513; Jena, 581; Munster, 467; Kiel, 463; and Rostock, 330. Of the total number 5,791 are studying theology, 5,769 law, 6,650 medicine, and 8,735 science or letters. One thousand six hundred and forty-four of the students are foreigners. The English element is conspicuous. America is also well represented.

RECENT INVENTIONS.

The following list has been compiled especially for the Scientific News, *by Messrs.* W. P. Thompson *and* Boult, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

Candlestick.—Mr. F. Bosshardt, on behalf of Mr. J. T. Warburton, New Zealand, has patented a candlestick, designed to hold candles of various sizes. Two or more spring arms are rivetted to the bottom of the candlestick, and are curved upwards, the upper ends being curved concavely to grip the candle. A disc attached to the apex of the extinguisher is pressed against the bottom of the candle to raise it.

Hot Water Boiler.—Mr. W. L. Milne, of Hounslow Road, New Hampton, has patented a boiler for heating water for circulation in warming buildings. The invention consists in constructing a boiler of the saddle form, provided with internal flue tubes at the sides, and through the crown of the boiler. The flue tubes passing through the water in the boiler thereby increase the heating surface of the boiler and economises fuel.

Fog Signalling Apparatus. — Mr. G. F. Attree, of Hanover Crescent, Brighton, has patented an apparatus for fog signalling. In carrying out this invention an arm pivotted vertically is attached to the engine, which is moved from its vertical position by coming in contact with a projecting arm set by the signalman, such movement of the engine-arm actuating the means attached to the engine for warning the driver.

Lawn-Tennis Marker.—Messrs. J. McHardy and R. Bland, of North Britain, have patented a lawn tennis-court marker. A deep narrow vessel diminishing in size towards the bottom is provided with three rollers and a wheel, over which a marking band passes, carrying the marking liquid from the tank to the ground, when the marker is wheeled along. One of the rollers is placed at the bottom of the tank, in order that the whole of the marking material may be used up, and a lid covers part of the vessel, the belt itself forming a lid for the remainder.

Tea Blender.—Mr. E. Burke, of High Street, Dublin, has patented a tea blender. Within the cylinder are arranged a number of shelves or slides, each forming an acute angle with the circumference of the cylinder. In the central portion of the cylinder is arranged a disc or diaphragm at an inclined angle to the axis, and held in this position by a rod, the extremities of which are secured to the ends of the cylinder by angle pieces. This disc or diaphragm in rotating with the cylinder assumes a peculiar rotatory motion, causing the tea or other substance, undergoing treatment, to be thrown from end to end of the cylinder.

Almond-Splitting.—A machine for this purpose has been patented by Mr. J. L. Collier, of 80, Gray's Inn Road, London. The machine is constructed of two inclined standards, between which are two rubber rollers, the top roller resting upon the bottom one, and the two are geared by spur wheels, the top roller being kept in position by bushes placed in front. In the centre is a fixed knife, held in position by screws. An inclined table is

fitted to the back of the machine, so that when the almonds are fed on to this table they slide down to the rollers, through which they are drawn and forced against the knife, which splits them through the centre.

Automatic Temperature Regulator.—An apparatus for regulating temperature has been patented by Mr. A. B. Willway and Mr. E. Moon, both of Bristol. In a casing is arranged a coil of metal of two different expansive natures, and through the centre of the coil passes a pipe conveying steam. The coil terminates in a tail-piece on which is placed a valve, working in connection with an outlet from the casing, which is also provided with an inlet aperture. When the steam is passed through the tube in the centre of the coil, the difference of expansion between the two metals causes the metal strip to uncoil, which, acting on the valve, closes, or partially closes, the outlet aperture.

Fire-damp Tester.—An apparatus for detecting fire-damp has been patented by Mr. B. J. B. Mills on behalf of Mr. N. W. Perry, United States. A strip of platinum or palladium, coated on one side with gold, occludes fire-damp, etc., and so expands most on the uncoated side, thereby bending upwards and closing an electric alarm circuit; or the terminals of the circuit can be placed in some non-conducting compounds of the above metals such as palladium oxide, which is reduced in the cold by hydrocarbon gases to the conducting metal, which therefore closes the circuit. Or a block of platinized or palladinized charcoal may be attached to a thermopile, which actuates a relay circuit containing the alarum.

Colorimeter.—An apparatus for testing the intensity of colour of transparent bodies has been patented by Mr. J. W. Lovibond, 26, St. Ann Street, Salisbury. The apparatus consists of two tubes separated by a wedge-shaped partition so that they are slightly inclined to one another. An eye-piece is fitted to command a view of both tubes, the other ends of which are open, or merely covered by a screen of ground glass so as to freely admit light. In one tube is placed a block of the substance to be tested, a definite thickness of course being chosen, generally one inch; in the case of liquids a containing vessel of white glass is used. Into slots in the other tube a series of coloured glasses of standard intensity are placed until the required shade is obtained as viewed through the eye-piece.

Electrical Switch.—An automatic switch for electric alarms has been patented by Mr. H. C. Chocqued, Melrose Gardens, West Kensington. Through a case of insulating material is passed a rod of metal moving freely, and projecting at each end through suitable openings in the case. This rod carries a tongue, which, by shifting the rod in either direction, is caused to impinge on a contact, and so close a circuit, which comprises a battery and an alarm bell. The rod is so controlled by a spring that it tends to press on one of the contacts. The rod is held back against the spring, so that its tongue is midway between the contacts, by means of a cord connecting one of the ends of the rod with the door or article by the movement of which the alarm is sounded. Thus if the cord be pulled or allowed to slacken, the tongue of the rod will be moved against one of the contacts, and the alarm sounded.

ANNOUNCEMENTS.

London Society for the Extension of University Teaching.—On the 3rd inst. Sir James Paget, F.R.S., will give, at the Mansion House, at 3.30 p.m., the annual address to the students of this Society. The subject of the address will be "Scientific Study."

The Professorship of Botany at Edinburgh.—Dr. Isaac Bayley Balfour, Sherardian Professor of Botany in Oxford University, has been appointed Professor of Botany at Edinburgh University, in succession to the late Professor Dickson. Professor Balfour is the son of the late Mr. Balfour, who occupied the chair of Botany at Edinburgh so long. He succeeded the late Dr. Dickson at Glasgow, removing to Oxford in 1884.

Hygiene and Life-saving Exhibition at Ostend.—Under the auspices of the Communal Administration of Ostend an International Exhibition of Hygiene and Sauvetage will be held in the Parc Léopold. The Exhibition will remain open from the 1st June to 1st October, and will include all that relates to public, private, industrial, naval, and maritime hygiene. There will be a special section connected with childhood, and another devoted to the saving of human life under various circumstances. Further information may be obtained on application to the Organising Committee, 3, Rue des Regnesses, Ghent.

Institution of Mechanical Engineers.—The summer meeting will this year be held in Dublin, an interval of twenty-three years having elapsed since the previous meeting in the capital of Ireland. The Provost and Senior Fellows of Trinity College have obligingly offered every facility and accommodation in their power; and the members will thus enjoy a renewal of the hospitable reception which was accorded to them on the occasion of their former visit. The meeting will commence on Tuesday the 31st of July, and will last four days. Further particulars will be announced in due course.

Canals and Inland Navigation.—It is the intention of the Society of Arts to hold a conference in May next on the subject of canals and inland navigation. In the year 1885 an international conference on this subject was held at Brussels, and in the following year there was one at Vienna. The third meeting is to be this year at Frankfort. It is not, however, proposed that the Society of Arts Conference should be of an international character, as naturally the canals of this country are not in any way dependent on, or connected with, those of other countries. Amongst the subjects set down for discussion are included the history of canals in Great Britain, the engineering of canals, the present condition of canal navigation, with suggestions for its improvement, the connection between canals and railways, tariffs, cost of carriage, etc. It is also proposed to include in the proceedings some account of the canal systems of foreign countries, and the committee have already been promised several papers on this head. Further information as to the details of the arrangements may be obtained from the Secretary of the Society of Arts.

St. Dunstan's Senior Exhibitions.—Three exhibitions, each of the value of £100 a year for three years, will be awarded on the results of an examination to be held in June, 1888, to girls under 19, on the first day of the examination, and resident within the area of the metropolis as defined in the Elementary Education Act, 1870. The exhibition will be for the purpose of enabling the holders to fit themselves for the practice of teaching, or the medical or any other profession, and will be tenable at any place of higher education approved by the Governors. The exhibitioners must, in the opinion of the Governors, be in need of assistance for the above purpose, and they will not be allowed to hold any other exhibition, scholarship, or similar emolument, without permission from the Governors. Forms of entry for the examination may be obtained on application to Hugh Cooke, Esq., Clerk to the Governors of the Charities of St. Dunstan's-in-the-East. The forms must be returned, filled up, on or before April 30th.

DIARY FOR NEXT WEEK.

Monday, Mar. 5.—Royal Institution, at 5 p.m. — General Monthly Meeting.

Society of Arts, at 8 p.m.—Cantor Lecture. *The Modern Microscope;* Mr. John Mayall, junr.

Victoria Institute, at 8 p.m.—*Oriental Entomology;* Rev. F. A. Walker, D.D.

London Institution, at 5 p.m.—*Glimpses into the Parochial History of the City of London, as gathered from the Records;* Mr. Edwin Freshfield, LL.D.

Society of Engineers, at 7.30 p.m.—*The Effect of Sea-water on Portland Cement;* Mr. Henry Faija.

Aristotelian Society, at 5 p.m.—*Short Papers on Various Subjects.*

Society of Chemical Industry, at 8 p.m.—*The Recovery of Sulphur from Alkali Waste by Means of Lime-kiln Gases.*—Mr. Alexander M. Chance.

Tuesday, Mar. 6.—Royal Institution, at 3 p.m.—*Before and after Darwin;* Professor G. J. Romanes.

Institution of Civil Engineers, at 8 p.m.

Society of Arts. Foreign and Colonial Section, at 8 p.m.—*South African Goldfields;* Mr. W. H. Penning.

Society of Biblical Archæology, at 8 p.m.—*Le Manuscrit Copte No. 1 de la Bibliothèque de Lord Louche;* Professor Amélinean. *Textes Egyptiens et Chaldéens relatifs à l'intercession des vivants en faveur des mortes;* Professor Revillout.

Wednesday, Mar. 7.—Society of Arts, at 8 p.m.—*Frame-work Knitting;* Mr. W. T. Rowlett.

Entomological Society, at 7 p.m.

Royal Dublin Society, at 4 p.m.—*Recent Scientific Inventions;* Professor W. F. Barrett.

Royal United Service Institution.—*The condition of the Mercantile Marine, Personal and Material, with a View to its more Complete Utilisation as a Reserve for the Royal Navy;* Captain W. Crutchley.

Thursday, Mar. 8.—Royal Society, at 4.30 p.m.

Royal Institution, at 3 p.m.—*Microscopic Work on the Least and Simplest Forms of Life;* Rev. W. H. Dallinger.

London Institution, at 6 p.m.—*On Sound-producing Organs in the Animal World;* Professor Charles Stewart.

Edinburgh Architectural Association.—*The Prevention of Down Draught in the Ventilation of Buildings, with a New Formula for Calculating the Size of Outlet Pipes and Wind-acting Exhaust Ventilators;* Mr. W. P. Buchan.

Society of Telegraph Engineers and Electricians, at 8 p.m.

Friday, Mar. 9.—Royal Institution at 9 p.m.—*S. T. Coleridge;* Mr. Leslie Stephen.

Royal Dublin Society, at 4 p.m. Electrolysis.—*The Relation of Electricity to Chemical Action;* Professor W. A. Tilden, D.Sc.

Institution of Civil Engineers, at 7.30 p.m. —*The Prevention and Extinction of Fires;* Mr. Alfred Chatterton, B.Sc.

Saturday, Mar. 10.—Royal Institution, at 3 p.m.—*The Modern Drama;* Mr. W. Archer.

Physical Society, at 3 p.m.—*On a Reflecting Galvanometer;* Mr. G. L. Addenbroke. *On a Theory Concerning the Sudden Loss of Magnetic Properties of Iron and Nickel at High Temperature;* Mr. Herbert Tomlinson.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

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EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Wanted, a Browning's Platyscopic Lens, for geological purposes.—C. CARUS-WILSON, West Bournemouth, Hants.

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SELECTED BOOKS.

The Story of Creation. By E. Clodd. London: Longmans, Green, and Co. Price 6s.

Treatise on Photography. By Captain W. de W. Abney. Fifth Edition. London: Longmans, Green, and Co. Price 3s. 6d.

Short Studies from Nature. London: Cassell and Co.

Playground of Science. By Johnston Stephens. London: Truslove and Shirley. 1s.

NOTICES.

The Title Page and Index to Vol. I., *First Series,* now ready, price 6d.

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Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

POISONS AND POISONING.—As was to be expected, Dr. Meymott Tidy's lecture on this subject at the Royal Institution was adorned with some of his amusing rhetorical flourishes, but at the same time it was interesting and instructive. After explaining the etymology of the word toxicology, and endeavouring to define the exact meaning of "poisons," he described the characteristic effects of some of the well-known poisons. He showed, for instance, that the hæmoglobin, or red colouring matter of blood, gives a certain well-defined spectrum, and that when the hæmoglobin is combined with the poisonous gas carbonic oxide, there is an additional band in the spectrum. He showed incidentally that the spectroscope is not only of great use in the detection of some poisons, but in the detection of blood itself in criminal cases, and he experimented with a spot of blood on a portion of a victim's hat, which was many years old. He treated the supposed blood with citric acid, and on testing the solution with the spectroscope, the spectrum of reduced hæmatin was at once visible. He also pointed out the remarkable fact that many substances which are chemically alike are totally different in their physiological action. Thus cyanogen is the most poisonous gas known, but another substance, para-cyanogen, which has the same chemical composition, is an absolutely inert solid. Piperine and morphine are also chemically alike, but the former has the effect of waking up, whereas the latter produces sleep. The case of oxygen and ozone is also very striking; we cannot live without a good deal of the former, though in much of the latter, which is the same chemical element in a different state, we should die.

THE TECHNICAL EDUCATION BILL.—We give elsewhere an abridgment of Mr. Swire Smith's able paper on this subject, read at the Society of Arts, and we feel sure that it will help many to have a better understanding of the true bearings of the important questions involved. Mr. Swire Smith speaks with authority, for not only did he serve on the Royal Commission and visit the leading technical schools of Europe and America, but he has had much to do in founding and conducting some of the leading technical schools in Yorkshire. It is his opinion that in the production of staple goods and metal work of various kinds we are within measurable distance of being equalled, if not surpassed; and he attributes this, in most cases, not to the longer hours and the lower wages of foreign operatives, as is generally supposed, but to the superiority, attractiveness, or novelty of the goods themselves. The Commissioners discovered English machines in foreign countries which were producing better, more attractive, and more saleable goods than were being produced by similar machines in competing manufactories in England. This is believed to be due to the scientific or artistic training of the employers, foremen, designers, chemists, or workmen where the goods are produced. Mr. Smith says that in every industry, in competing countries abroad, those persons

who are responsible for the designing, shaping, finishing, colouring, or making up of a fancy article, whether it be in metal work, pottery, furniture, or a woven or printed fabric, have almost invariably received some training in art or science, or have gone through a special technical school.

In England the majority of persons holding similar positions have received no artistic or scientific training whatever except when, as often happens, those positions are held by foreign designers or chemists, or by Englishmen who have been trained in foreign countries. This is a plain statement of facts carefully collected by thoroughly competent commissioners, and we agree with Mr. Smith that it is sufficiently humiliating to be compelled to acknowledge that, in the industrial contest of to-day, English machinery is being employed to better and more profitable account by some of our rivals than by ourselves; but it is infinitely more serious and more humiliating to find that in the conditions of training which best tend to promote future efficiency and success, the rising generations of other countries are being far better prepared than those of England. Our saving clause appears to be the testimony of the most competent judges that whether in art, science, or technical skill the Englishman is not surpassed by the foreigner when his faculties have the advantage of equal cultivation. It is evident that something must be done, and that soon, but there is of course no reason why we should act in a panic-stricken way, as some seem inclined to do; and as Sir Henry Roscoe pointed out, in the discussion which followed the reading of the paper, we must be careful not to imitate exactly Continental methods. We, in England, have certain growths of our own, which we ought to foster and develop, and whilst benefiting by the experience of other countries, it would be the greatest mistake to copy servilely either the French, German, or other Continental models.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Very few of the readers of Scientific News would understand me if I referred without explanation to "Murphy's Day." I will therefore premise that Murphy is not one of the saints of the calendar, but the author of an original calendar entitled "Murphy's Weather Almanac," in which he boldly ventured, on the basis of some curious magnetic theory to predict the daily weather of a whole year. His effort attracted but little notice until one very remarkable morning when the thermometer fell below zero of Fahrenheit in Hyde Park and at Greenwich. It was about the coldest morning of the century, and Murphy predicted such weather on that date. An immense excitement followed in London. The publisher's house was besieged daily with crowds of intending buyers, and enormous numbers of the almanac were sold. The comic papers were not then a national institution; their place was still occupied by the street ballad singer. I just remember two lines of one of the Murphy ballads that was very popular. They ran thus—

"Murphy has a *weather* eye;
He can tell whenever he pleases
Whether the *weather's* wet or dry,
Whether it thunders or *whether* it freezes."

Further comparison between the subsequent predictions and subsequent facts proved that his pretensions were no greater than those described in the ballad. The lucky hit was an accident.

Murphy is forgotten, but in the minds of many the American meteorologists have taken his place. Their telegrams are distorted into positive predictions for us, while as a matter of fact the majority of them are mere statements of the fact that a certain cyclone or anti-cyclone is travelling towards us. Their powers are similar to those which were credited by the ballad to Murphy. Mr. H. Scott has lately stated that the track of the depressions is determined by the distribution of pressure over the ocean, and that at the time of the despatch of the American telegrams we are ignorant of this distribution; therefore such telegrams are of no assistance to the meteorological office in issuing storm warnings.

It appears to me that there is a simple and intelligible reason why the journey of such depressions across the Atlantic from America to our shores should usually be disturbed. Between the United States and Britain are two great conflicting oceanic currents which must be crossed by the air which travels from New York or Washington to Liverpool or London. They differ greatly in temperature. The cold Arctic current sweeps forcibly along the coast of Labrador, then is deflected outwards by Newfoundland, but still works southwards in a track between the American coast and mid-ocean. Westward of this is the warm tropical current usually styled the Gulf Stream, which sweeps northward along the coast of Florida, and is then deflected westwards and crosses by a N.W. course to our shores. The two currents collide obliquely somewhere about mid-ocean. Thus every atmospheric speciality that starts from America on its way towards us encounters these two contradictory oceanic rivers, which necessarily disturb it, and in doing so dislocate all prediction, however plausible may be its basis.

One of the enigmas that have much exercised the ingenuity of geologists is that presented by the frozen-up mammoths of Siberia. Here are found huge animals that belong to the fossil world, and yet are not mere fossil skeletons, but whole creatures in the flesh, with hair and all intact, preserved in ice like New Zealand mutton, so fresh they may even be cooked and eaten with impunity. How came they there, seeing that, in spite of their hairy sides and back, they are herbivora that must have lived in a climate where vegetation is abundant? They are, in fact, nearly allied to tropical and sub-tropical elephants; their bones, found in other places with those of other animals, indicate a habitat in the temperate zones.

They must somehow have been caught napping by a sudden change of climate, and their fate has suggested many speculations concerning the cause of such sudden change. Has the axis of the earth shifted? Have they been caught by mighty floods, followed by mysterious

change of climate? Or has the whole country been suddenly upheaved and suddenly depressed? Have they been entombed by a single catastrophe or by a series? etc. The controversy has of late become mixed up with theological controversy, and, as usual, this element has rather magnified the confusion and discordance of hypothesis.

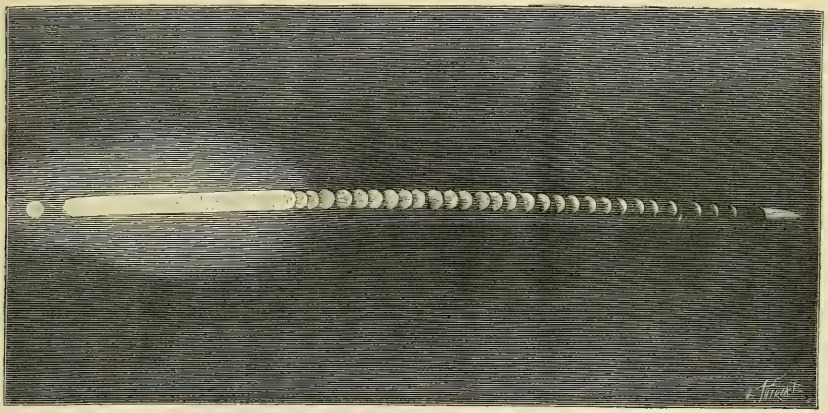
Under these circumstances I perpetrate the presumption of offering an original explanation which, so far as I can learn, is also new. It is this. Siberia, as a glance at a good map will show, is a vast plain intersected with very long sluggish rivers, extending over a great range of latitude. In the winter the northern regions of this great area include the very coldest part of the known world. In the summer these plains are luxuriant to an extent scarcely credible to those who have not experienced the torrid contradictions of an arctic summer, due to the continuance of sunshine all through the day and all the night. The southern limits of these plains are fully within the temperate zone. The Irtish and Ienisei rivers flow from the latitude of Venice into the Arctic Ocean.

My theory is, in the presence of these data, very simple, viz., that the mammoths of old behaved on land as the swallows of to-day behave in the air. We know that the elephant can run, can persevere in running, provided the ground is favourable for such locomotion. What, then, was there to prevent such an animal from following the sun at the rate of, say, 100 miles per day, or 10 deg. of latitude per week, and thereby following the growth of the great supplies of food that so large a beast must require. Following the banks of one of the great Siberian rivers, the southern journey of 2,000 and odd miles would be a mere holiday trip for such monsters, and the return journey down hill still easier.

But such journeys must have exposed them to occasional disasters. An early and sudden arrival of winter, a blizzard, or a flood, would in the ordinary course sometimes overwhelm the hindmost and sweep their carcases into the river. As all these rivers flow northward, these carcases would drift with the first winter ice to the places where they are now found, *i.e.*, on the banks of rivers which have been undermined by floods.

THE LATE ECLIPSE OF THE MOON.

THE subjoined illustration, taken from *La Nature*, shows the successive stages of this eclipse as represented in an intermittent photograph. The moon's apparent course is traced as a luminous band. The lens of the camera was alternately opened for four seconds, closed for five minutes, then again opened and closed as before, the operation being repeated until the disc of the moon was entirely covered, and no further proofs were obtainable. The practicability of taking photographic views by moonlight was shown in SCIENTIFIC NEWS, vol. i., p. 106, First Series; and on p. 162 of the same volume we gave a continuous photograph of the satellite during a partial eclipse.



INTERMITTENT PHOTOGRAPH OF THE ECLIPSE OF THE MOON.

SHIP WAVES.

EVERY one who has watched a boat or ship progressing through comparatively still water, or a water-fowl forging its way across some quiet pond, must have noticed the waves or ripples which are caused thereby, and which stretch out in a long series far and wide on each side in the wake of the moving body. As may well be imagined, owing to the peculiar complexity of the circumstances, the scientific investigation of the configuration and pattern of these waves forms a most difficult problem, requiring for its solution great power of reasoning and high mathematical skill. That the subject, however, can be made popularly attractive has been lately shown in a lecture delivered by Sir William Thomson at the recent meeting of the Institution of Mechanical Engineers in Edinburgh. The learned lecturer defined a wave as "the progression through matter of a state of motion. Look at a field of corn on a windy day. You see that there is something travelling

over it. That something is *not* the ears of corn carried from one side of the field to the other, but *is* the change of colour due to your seeing the sides or lower ends of the ears of corn instead of the tops. A laying down of the stalk is the thing that travels in the wave passing over the cornfield. The thing that travels in the wave of water is an elevation of the water at the crest, and a depression in the hollow." Dealing with the procession of waves formed by a boat dragged along a canal, Sir William alluded to the splendid researches made in connection with that branch of the subject by Scott Russell more than half a century before, which brought about the discovery that this procession of waves in the rear only occurs when the speed of the boat is less than a certain limit. This discovery led to the Scottish system of fly-boats, carrying passengers on the Glasgow and Ardrossan Canal, and between Edinburgh on the Forth and Clyde Canal, at speeds of from eight to thirteen miles an hour, each boat drawn by a horse or pair of horses galloping along the bank. The method originated from the accident of a spirited horse whose duty it was to drag the boat along at a slow walking speed, taking fright, and running off, drawing the boat after him. It was discovered that, when the speed exceeded the velocity acquired by a body falling through a height equal to half the depth of the canal, the foaming, stern surge, which used to devastate the banks, ceased, and the vessel was carried on through water comparatively smooth, with a resistance greatly diminished. The mercantile value of this fact was readily perceived and taken advantage of. Special light boats, sixty feet long, and six feet wide, were constructed of thin sheet iron, and drawn by a pair of horses. The boat was started at a slow velocity behind the wave, and at a given signal it was by a sudden jerk of the horses drawn up on the top of the wave, where it moved with diminished resistance, at the rate of seven, eight, or nine miles an hour. In illustration of this same principle Scott Russell was quoted also as saying, "Two or three years ago it happened that a large canal in England was closed against general trade by want of water, drought having reduced the depth from twelve to five feet. It was now found that the motion of the light boats was rendered more easy than before: the cause is obvious. The velocity of the wave was so much reduced by the diminished depth, that, instead of remaining behind the wave, the vessels rode on the summit."

Leaving canal waves, and turning to waves made by ships in the open sea, Sir William paid eloquent testimony to the valuable investigation made by Mr. William Froude and his son, and said that the whole pattern of waves is comprised between two straight lines drawn from the bow of the ship, and inclined to the wake on its two sides at equal angles of 19° 28′. He then drew attention to the wave-profile for certain ships, and pointed out how from the appearance of the waves raised by ships going at high speeds it may be learnt how quickly they were going. After defining that the "entrance" is that part of the ship forward where it enters the water, and swells out to the full breadth of the ship, and that the "run" is the after part, extending from where the ship begins to narrow to the stern, the lecturer explained the advantages and disadvantages of a parallel middle body being introduced between the entrance and run, and showed that it produced a good or bad effect according to the relation of the wave length to the length of the ship. When the effect of the entrance or bow, and the effect of the run or stern was such as to annul, or partially to annul each other's influence in the production of waves, then we had a favourable speed for that particular size and shape of ship. On the other hand, when the crest of a wave astern, due to the action of the bow agreed with the crest of a wave astern due to that of the stern, then we had an unfavourable speed for that particular size of ship.

In conclusion, Sir William suggested that in order to get high speeds of eighteen and twenty knots an hour a return should be made to the old French lines for vessels. It was probable that by swelling out the ship below in that old fashion, instead of having vertical sides—making the breadth of beam say five feet more below the water than at the water-line, a large addition might be obtained to the displacement or carrying power of the ship, with very little addition to the wave disturbance and wave resistance.

ELECTRIC PROJECTION MICROSCOPE.

IN our climate the solar microscope cannot be depended upon for exhibiting microscopic objects to a class of students or at a lecture, and the lime-light, with its cumbrous belongings and its risk of accidents, is not all that might be desired. We are, therefore, glad to have the opportunity of giving a description and illustration of the electric projection microscope, devised by Professor Selenka, of the Zoological Institute of the University of Erlangen.

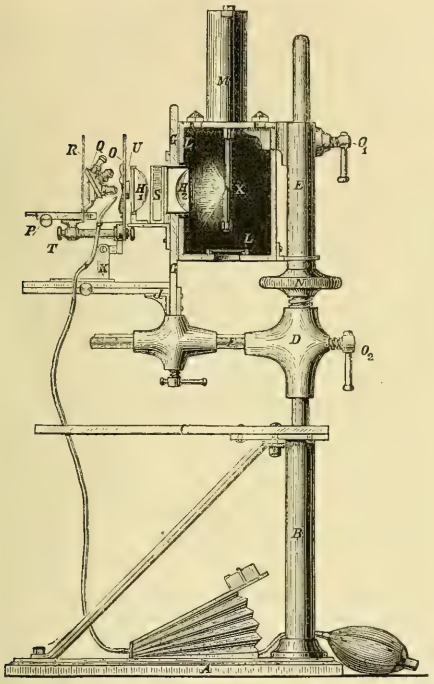
The stand (A) is of cast-iron, with a vertical support (B). At a convenient height there is a board (C), on which are laid the preparations, and above this board are arranged two iron tubular pieces (D and E), the one above the other, which receive a strong iron bearing-rod, and can be fixed by means of the set-screws (O_1 and O_2). The lower and shorter of these tubes supports on the horizontal arm (F) the plate (G), with the condensers (H_1 and H_2), as well as the table (J) with the microscope (K). To the upper and longer tube (E) is fixed the light-chamber (L), with the arc lamp (M) screwed on above. The arc lamp used is on the Piette-Krizik system, which, in consequence of its easy and accurate regulation, is especially suitable.

The arc lamp (M) can be moved up and down, so that the electric arc (X) can be adjusted to the optical axis of the two condensers[1] This adjustment is effected by turning to the right or the left an iron disc (N), placed between D and E, and provided with an internal thread upon the thread of D, so that, at the same time as D, the tube (E), with the light-chamber (L) and the arc lamp (M), moves up and down, and the luminous point (X) is set higher or lower. A displacement of E with the light-chamber is not possible, because the plate (G)—which closes the light-chamber (L) in front, and carries the condensers (H_1 and H_2) and the glass-trough (S)—runs in grooves in the front edge of the light-chamber, so that these parts can only move vertically. O is the object-bearer; P a rack-work; Q an objective-revolver; R a screen, with an aperture one centimetre wide; and T the micrometer screw.

The light-chamber is made of strong oak, and to its lid is screwed the arc lamp, from which hang down the two iron rods supporting the carbons. In the lid of the light-chamber there are, besides the aperture for the carbons, some ventilation-holes for the escape of the heat. These

holes are provided with screen tops to prevent the emission of light. The left side of the light-box is entirely closed, but the right side is fitted with a door for the introduction of fresh carbons, etc.

In the middle of the door is a round hole, covered with dark-coloured glass for examining the light. In the bottom of the light-box there is a round opening for illuminating the preparation table and promoting ventilation. Over this aperture there lies, supported on ribs, a dark glass, which moderates the light and catches the falling ashes. Between the two condensers is the glass trough (S), with plane sides, filled with a saturated solution of alum to arrest the heat-rays. But, lest massive or dark-coloured objects should be too strongly



heated, a current of cold air is forced upon the preparation by means of a flexible tube coming from the bellows on the foot (A).

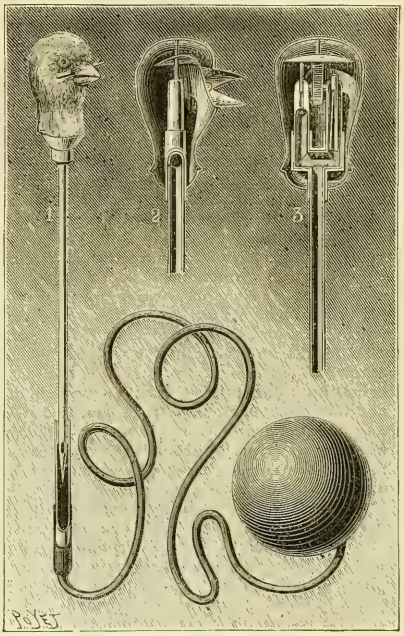
The arc light requires a current of ten ampères and a tension of fifty volts, and has, if thus supplied, a 1,200 candle-power. This strength of light suffices for a magnifying power of 1,000 diameters. But for using oil immersions it can be intensified by means of the achromatic condenser, devised by Professor Abbe, and manufactured by Zeiss, of Jena. In this manner an illumination is obtained equal to that of 2,500 normal candles.

At the distance of five and a-half yards from the screen the contractile vacuoles, and the granular current in living amœbæ, as well as the ciliary movement in infusoria, can be seen.

We need scarcely say that this apparatus will be of the highest value to professors of every department of the organic sciences.

AN ANIMATED TRINKET.

A SKILFUL mechanician, says *La Nature*, has recently submitted to our examination an animated trinket which is a wonder of ingenuity. It is a neck-tie pin in the form of a bird's head. The wearer asks some one to look at his scarf-pin, and at the same moment the bird opens its beak and utters a short but very expressive warbling. The engraving represents the mechanism. The pin (fig. 1) has attached to its lower part a caoutchouc pipe terminating in a ball, which is kept in the pocket. On pressing this ball with the hand, air is forced up the tube and acts on the mechanism in the head of the bird. The sections 2 and 3 show the



arrangement. The air passing along one of the branches of a U tube circulates through a little whistle, and in the other branch it raises a small piston fitted with a counterpoise which opens the beak of the bird.

Adhesive Gum for Labels.—The following mixture is given by M. Eliel for a strongly adhesive gum, which will really make paper or parchment paper stick to any surface on which it may be applied, such as wood, glass, stone, or metal of any kind. It is made thus:—

Gum acacia	120 parts
„ tragacanth	30 „
Glycerine	120 „
Thymol	2½ „
(or) Australian eucalyptus oil	3¾ „
Water, sufficient to make up to 1,000 parts	

THE VISION OF SPIDERS.

ACCORDING to "Cosmos," Professor Plateau has been examining the organs of sight among the *Arachneida*. Their development in this respect is far from uniform. Some, like the scorpions, shun the daylight, and must depend upon chance or upon their other senses for the capture of their prey. Others, like the majority of the true *Aranеida*, hang out snares for insects, whilst other families in this group seek the light and live by hunting. In these latter the visual perceptions have reached the highest grade of development.

Thanks to the numerous eyes of the spider, it is popularly credited with excellent sight. Naturalists, however, have long ago refuted this error, and shown that these eyes, in virtue of their curious dimorphism discovered by Grenacher, are very indifferent instruments, or at least that their possessors must be very short-sighted. Muller and Lacordaire find that spiders see distinctly only to a very short distance. Dugès thinks that if a spider takes refuge in its hole at the approach of a man, even at the distance of a fathom, it is not necessary to suppose that it has any distinct vision at such a distance, but merely recognises moving masses.

The researches of M. Plateau have not merely confirmed these surmises, but have extended them in an unexpected manner. His minute experiments have been extended to various species of spiders, and have led him to conclude that the distance at which vision is sufficiently distinct to induce a spider to capture its prey is about an inch in the most sharp-sighted species, and that the vague perception of movements in *Epiblemum scenicum* does not exceed five to six inches.

The following observations, which the reader may verify in any garden on a fine day in the latter part of summer, fully confirm the statements of M. Plateau. If a blue-bottle falls into the web of a geometrical spider (*Epeira diadema*) she does not rush right to the spot, but applies her feet in rapid succession to the radii of the web, and thus ascertains by touch the exact position of the struggling prey. If the web is gently touched with a blade of grass or a soft feather she rushes to the attack, and does not at once perceive the fraud, but actually seizes the useless object.

We have seen a harry-long-legs get entangled in a cobweb in his blundering flight, and just manage to extricate himself in time, leaving a leg behind him as a forfeit. The spider, hurrying up, seized the leg, not noticing that it was bodyless, ran to the other end and then back to the first, only learning by very close examination that the booty was just a leg and nothing more. No creature having a moderate range of vision could be so deceived.

The conclusions of M. Plateau are that the *Araneida* in general perceive the movements of bulky bodies from a distance. The so-called hunting-spiders, such as the Lycosae, are probably the only ones which see the movements of small objects. They perceive such movements within a range, according to some observers, at from one inch to a foot, but which, according to Plateau, does not exceed six inches. Even at such small distances their sight is not distinct. Weaving spiders have a very poor sight at any distance, and only detect the presence and the position of their prey by the vibrations of the web.

The underground tube-spinning spiders, such as *Atypus piceus*, which may be observed on Hampstead Heath, are not guided by sight at all, but drive their fangs into any substance which comes in contact with the tube.

As regards scorpions the case is very similar. Their sight is poor, and its mean range does not extend beyond half an inch for the middle eyes and one to one and a quarter inch for the lateral eyes. These animals do not hunt, but ramble about or wait until some prey comes in their way. They judge by feeling where is the right place to plant their sting.

SULPHUR BACTERIA—"SEWAGE FUNGUS."

"SEWAGE fungus" is a name of dread to many persons who when they see it slowly swaying to and fro in the sluggish current of a ditch are haunted by dreams of "previous sewage pollution." In reality this unlovely plant grows merely in the presence of sulphur.

The bacteria belonging to the group *Beggiatoia* form long strings, and live together in great numbers, composing white slimy masses which may be found in sewers, ditches, in sulphur springs and in the drainage from certain chemical works. It is a great mistake to suppose that they have any necessary connection with putrescent animal matter, as they contain exceedingly little nitrogenous substance. It was formerly believed that they were capable of reducing sulphates present in water and thus generating that unpleasant gas known as sulphuretted hydrogen. But last year Winogradsky showed, in the *Botanische Zeitung*, that the presence of sulphuretted hydrogen in water is not the effect, but the cause, of the *Beggiatoa*. Sulphuretted hydrogen is formed, as was shown by Hoppe-Seyler, by the action of other bacteria upon sulphates. If *Beggiatoa* is cultivated in waters where other bacteria are excluded, they gradually lose their sulphur completely, even if the liquid holds sulphates in solution. They are consequently unable to reduce sulphates. But if sulphuretted hydrogen is added, they begin to store up sulphur and flourish accordingly. The sulphur thus collected is of a soft consistence and forms minute drops, each of which is inclosed in a film of plasma so that they cannot flow together. In the cell the sulphur is oxidised to sulphuric acid, which converts the carbonate of lime of the cell into sulphate (gypsum), even within the cell, when it is dissolved away. According to Winogradsky, this process corresponds to the oxidation of the carbohydrates in other organisms and is thus a kind of respiration. By the oxidation in the *Beggiatoa*, it obtains the energy necessary to maintain its life. It is easy to explain why the *Beggiatoa* should occur in waters containing mere traces of organic matter, as they can use this entirely for constructing their tissue, and have not, like other organisms, to expend it in heating. Some other bacteria are also able to store up sulphur.

CASTING ALUMINIUM.—Dr. C. C. Carroll, of Meadville, Pennsylvania, after years of experimenting, has discovered a method by which aluminium can be cast, soldered, and welded. It is considered by American metallurgists and artisans that this is a very valuable invention, since it ensures the use of aluminium for many purposes on account of its extreme lightness, strength, and non-oxidation by exposure. In the course of his experimenting Dr. Carroll believes he has also discovered the law governing the disintegration of iron-stringers employed in constructing railway bridges.—*Iron*.

General Notes.

Discovery of the Sarcophagus of Alexander the Great.—Further examination of the sarcophagi recently discovered at Saida, in Syria, shows that among them is the sarcophagus of Alexander the Great, containing the body of the monarch.

Dr. Clark's Visit to South Africa.—Dr. G. B. Clark, M.P., who has returned home from South Africa, travelled over 2,000 miles in Becuanaland, proceeding as far as the Tropic of Capricorn. His mission, which was of a semi-political character, has proved highly satisfactory.

Frauds in the Brandy Trade.—The phylloxera has been the ultimate cause of frauds and falsehoods not a few. The "cognac" now imported from France is to a great extent not derived from the grape, but is mixed with, or even entirely made up of, beet-root spirit or German potato-whisky, both of which are rich in the very injurious article known scientifically as amylic alcohol, and popularly as "fusel."

Distribution of the Nitric Ferment, and its part in the "Weathering" of Rocks.—A. Müntz (*Biedermann's Centralblatt*) remarks that this ferment occurs with great regularity on the surface of bare rocks in shady places, as well as in crevices. It is nourished by the organic matter and the salts brought down by rain. It acts like the lichens, both chemically and mechanically.

On the Function of Chlorophyll.—A. Nagamatsz (*Naturwissen Rundschau*) attempts to solve the following questions:—1. Can the leaves of land-plants assimilate under water? He found that if such leaves are entirely moistened with water, and consequently are not coated with a stratum of air, the answer must be in the negative. 2. Has light which has traversed an assimilating leaf the power to effect assimilation in a second leaf? This question also was decided in the negative.

Bottom Waves.—On a few occasions ships have suddenly been struck in calm weather by enormous waves, the cause of which was not obvious. In two of these cases, occurring in the Atlantic, the waves seem to have originated at a point about 50° N. lat. and 32·5° W. long. This is the point where the *Faraday* observed a reef rising 1,800 metres above the bottom of the Atlantic. It is conjectured that these waves are due to submarine volcanic action, having its seat near the reef.

The Parisian Water Supply.—During the past year the following dead animals were fished out of the Seine within the city walls:—2,021 dogs, 977 cats, 2,257 rats, 507 chickens and ducks, 3,066 kilos of butchers' refuse, 210 rabbits or hares, 10 sheep, 2 colts, 71 pigs, 49 geese and turkeys, 10 calves and goats, 3 monkeys, 1 snake, 2 squirrels, 3 porcupines, 1 parrot, 609 assorted birds, 3 foxes, 130 pigeons and partridges, 3 hedgehogs, 8 peacocks, and 1 seal. This, says the *Medical Press*, is, perhaps, barely meat enough for substantial broth, but too much for plain drink.

Preservation of Meat.—HH. L. Hemmann and A. Wieser, of Vienna, have invented an arrangement by which, according to *Uhland's Wochenschrift*, the raw flesh of oxen, etc., can be preserved for thirty days or upwards in a sound condition, and without the use of ice. The apparatus to be employed is a wooden chest of peculiar construction, fitted with several diffusion apertures serving as air-filters, besides an absorption apparatus as a gas generator. The working cost is smaller than that of ice, and the first cost of the apparatus is from thirty to forty florins.

South American Exploration.—Intelligence reaches us from Manaos (Brazil) that Colonel Labre, an explorer, has succeeded in ascending the Madeira River as far as Bolivia, descending by the rivers Madre de Dios and Acre, and thus discovering a means of communication between the Amazon territory and Bolivia that is free from those impediments—that is, the series of rapids of the Beni River, which up to now have had to be encountered. This is an important and notable discovery, and will undoubtedly tend to the rapid development of a rich and almost wholly unknown region.—*Panama Star and Herald.*

Mineral Phosphate of Lime.—Until recently it has been believed that the deposits of this mineral at Legrossan, in Spain, were unique in the world. Similar beds are now being discovered in various countries, especially in Tunis and Algeria. Some of the deposits contain as much as 35 per cent. of actual phosphoric acid, whilst in others the proportion falls as low as 10 per cent. These mineral phosphates, however, require to be rendered soluble by means of sulphuric acid, as their assimilation is otherwise too tedious for the nourishment of crops.

A Destructive Wave.—The *Panama Star and Herald* reports the occurrence of a huge wave at Baracoa, Cuba, which, according to published accounts, struck the beach, broke, and flowed inland, carrying many native huts and several good houses before it. After sweeping in fully 400ft. the water flowed back to the ocean. Nearly 300 huts and houses were destroyed, but no lives were lost, for the people saw it coming and fled to the hills. The beach was swept clear of every habitation that stood upon it. The wave was not a tidal wave, but the result of a three days' north wind.

Algeria.—Sir Lambert Playfair has just completed a very copious Bibliography of Algeria, which has been issued at the expense of the Royal Geographical Society, as one of their supplementary papers. Sir Lambert has been so long our Minister at Algiers that he is thoroughly familiar with the country and has studied it in all its aspects. The Bibliography, which covers 300 pages, has been a work of the most laborious character. It is arranged chronologically from 1541 downwards, and contains altogether 4,745 entries. Appended is an index of subjects and an index of authors. For anyone making inquiries concerning Algeria it is indispensable.

The New Comet.—Mr. Finlay, of the Royal Observatory, Cape of Good Hope, has computed the elements of the comet (of which the discovery was announced in Scientific News, page 199, vol. i., New Series), from observations made at the Cape; and from these elements Dr. Becker, of Lord Crawfurd's Observatory, has calcu-

lated the position of the comet to the end of the current month. From these calculations it appears that the brightness will increase until March 17, and then diminish again, until on the 29th it will be of the same brightness as on February 18th. The position at 12 o'clock on the night of March 6th was calculated to be :—Right ascension 20 hours 37·6 min. (increasing 3·7 min. daily); North Polar distance, 121°39′ (decreasing 1°30′ daily).

Discovery of Fossil Remains.—An interesting discovery has lately been made on the seacoast between Whitstable and Herne Bay. Mr. R. Goldfinch, a resident of the latter town, was walking along the beach, when, in the neighbourhood of Swalecliffe, his attention was attracted by a projection out of the clay in the Pliocene strata. Further examination showed the object to be the fossilised remains of some animal, and with assistance the specimen was dug out. The encrusted clay having been removed, it was found to be the tusk of a hairy Northern elephant (*Elephas primigenius*). In length the fossil is 57 in. along the curve, and its circumference at the thicker end is about 17 in., from which it tapers down to about 7 in. The fossil is in a very good state of preservation, with the exception of the tip, a small portion of which has been broken off.

Utility of Physiological Research.—An illustration of the practical utility of the study of bacteria has, according to *Invention*, recently occurred at New York. An Italian steamer arrived loaded with immigrants. There had been no cholera on board, but, as the vessel reached this port, a suspicious case of diarrhœa occurred in a child. The symptoms were not perfectly typical of cholera. Some of the dejections were taken, and sterilised tubes were inoculated and taken to the Carnegie Laboratory. It would take four days to develop the cultures, and the question arose whether the steamer should be delayed for that period of time. It was finally decided to do so. The cultures developed in the way characteristic of Asiatic cholera, and the diagnosis was made. Subsequently other cases of cholera appeared, and the culture diagnosis was abundantly confirmed. No more striking example of the utility of scientific studies could be furnished than the one referred to.

A New Germicide.—M. Maxinovitch calls attention to the value of β-naphthol as a germicide. It is, relatively speaking, non-poisonous, as 585 grammes of it are required to kill a man weighing 65 kilogrammes, or 1lb. to every hundredweight of the body, a dose in which no one is likely to indulge either from mistake or by intention. It is soluble in water to the extent of 0·4 part per 1,000. If introduced into a "culture-solution" to the extent of 0·10 part per 1,000, it prevents the development of the microbia of glanders, of chicken cholera, of splenic fever, of pneumonia, of suppuration, of typhoid fever, and of the diphtheria of pigeons. In the proportion of 0·20 per 1,000, it prevents the germination of the bacillus of tuberculosis. A contemporary suggests that this discovery has been made at the right time to tranquilise the public mind alarmed at the "microbian invasion with which we have been afflicted for some years." For some years? The invasion is not novel, but our eyes have lately been opened to see the enemy.

Gift of a Museum to University College, Dundee.—Some three months ago, Dr. Forbes Watson, the well-known authority on Indian produce, offered his great collection of commercial products to the University of Aberdeen. After three months' deliberation the University authorities found themselves unable to raise the purchase-money, and regretfully declined the offer. Dr. Forbes Watson then made the offer to Dundee. Dr. Carnelley and his father at once purchased the collection, and presented it to the University College. A great part of this collection was brought together as an official duty for the Indian Museum, and was presented by the department to Dr. Forbes Watson when that museum was broken up. It contains nearly 7,500 samples. Between 700 and 800 of these are fibres, including textiles and paper-making materials. There are over 500 dyes and dye stuffs, 500 oils and oil seeds, 600 or 700 gums, resins, and guttas, nearly 2,000 medicinal substances, and more than as many samples of food stuffs. —*Dundee Advertiser.*

Zoological Society's Gardens.—The Zoological Society's aviaries have just received an addition in the shape of some specimens of a rare pheasant from Central Asia, which have been brought home by Major Peacock, R.E., of the Afghan Frontier Commission. These birds belong to the species described by Mr. Sclater in 1883 as *Phasianus principalis*, from dead specimens procured on the Murghab River, in Northern Afghanistan, by Mr. Condie Stephen, by whom they were sent home for the Prince of Wales's collection. The living birds are not in very good plumage at present, owing to the hardships experienced during their long journey and the confined space in which they were necessarily packed, but the species to which they belong is a very fine one, remarkable for the red and purple plumage and white wings of the cock bird, with a much longer tail than in the ordinary pheasant. Major Peacock's specimens were captured at Akcha, in Afghan Turkestan, on the 25th of January last, and were brought home at the special request of Sir Peter Lumsden, who called Major Peacock's attention to the desirability of introducing living examples of this splendid pheasant into Europe.

Reputation.—The late Professor Moses Stuart Phelps used to tell the following story. In the days when he was a graduate student at New Haven, he took a walk one morning with Professor Newton, who lived in the world of mathematics. Professor Newton, as is his habit, started off on the discussion of an abstruse problem. As the Professor went deeper and deeper, Mr. Phelps' mind wandered farther and farther from what was being said. At last Mr. Phelps' attention was called back to his companion by the Professor's winding up with, "Which you see gives us x." "Does it?" asked Mr. Phelps, thinking that in politeness he ought to reply something "Why, doesn't it?" excitedly exclaimed the Professor, alarmed at the possibility that a flaw had been detected in his calculations. Quickly his mind ran back over his work. There had, indeed, been a mistake. "You are right, Mr, Phelps, you are right!" almost shouted the Professor. "It doesn't give us x, it gives us y." And from that hour Professor Newton looked upon Mr. Phelps as a mathematical prodigy. He was the first man who caught the Professor tripping. "And so," Mr. Phelps used often to add, with his own peculiar smile, in telling the story "I achieved a reputation for knowing a thing I hate."—*Inquirer.*

STORMS.—II.

(Continued from page 197.)

THE tropical cyclones or hurricanes, which are smaller and have much stronger winds, move only from 50 to 300 miles a day. At the actual centre there is a calm and usually blue sky which is swept clear of clouds by the uprushing air; this is called the "eye of the storm" or the "bull's eye." A still smaller atmospheric whirl of two or three hundred yards diameter is produced by the most violent winds that are known, and is called a tornado. The pressure is so greatly diminished that trees, fragments of ruined buildings, and even human beings are caught up from the ground and carried to considerable distances. It is very remarkable that such a storm does not disturb the higher regions of the air, and the central spout does not extend higher than the lowest layer of clouds. Tornadoes travel usually to the north-east in the northern hemisphere, rotating in a direction opposite to that of the hands of a watch, and moving at about thirty miles an hour. On a still smaller scale, the violence of the wind is fortunately less, as in the case of water-spouts, which are produced in an exactly similar way; and creating as they do a vacuum sufficiently great to draw up water to the clouds, would do great damage to a ship; but they are the effect of a whirlwind of only ten or twelve feet in diameter. And lastly we have the eddy on a dusty road, a few inches, perhaps, in diameter. Such a miniature whirlwind may be artificially produced by means of the apparatus described in SCIENTIFIC NEWS, p. 67, vol. i., No. 3, First Series.

The large cyclones of the temperate zones not only move with such rapidity, and are of so large an extent that it would be impossible for a vessel at sea to avoid them, but they are very uncertain in their movements. A large number have been traced across the Atlantic, and among the admirable publications of the United States Bureau of Navigation is a chart of the North Atlantic Ocean, showing the tracks of more than twenty storms which have travelled towards our shores. Our newspapers often give a message from America to say that a storm may be expected at about a certain date, and there are persons who place such confidence in these warnings that they put down casual showers of rain, snowstorms, frosts or even fogs to the credit of the prophesy! The number of storms which actually cross the Atlantic in a year is given by Mr. Abercromby as from eight to twenty. The chart before us shows nineteen tracks crossing long. 60 degs., which lies between Newfoundland and Nova Scotia; and of these, six appear to reach long. 10 degs., which lies on the west coast of Ireland. Some of them have become spent in mid ocean, others have turned to the north or the south. A cyclone takes from four to ten days to make the passage.

The West Indian hurricanes are fortunately as regular in their movements as they are disastrous in their effects. The circular published by the U.S. Hydrographic Office on this subject recommends that when a

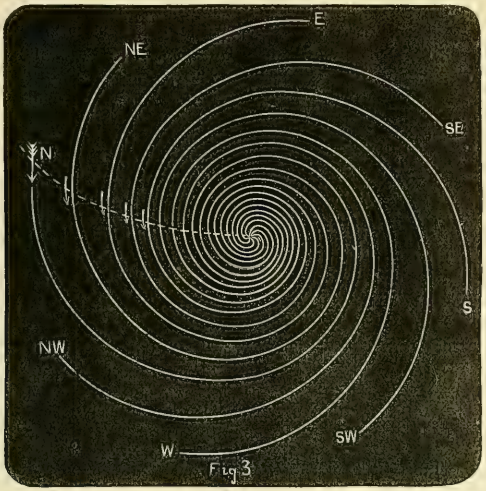


Fig 3

hurricane is evidently approaching, the captain should heave-to and carefully make and record observations of the barometer, thermometer, wind and weather, every half hour or even more frequently, with the view of finding the direction of the centre of the storm, the direction in which it is moving, and the position of the ship with regard to it. The two diagrams which are reduced from those given in the circular show the direction of the wind and the state of the barometer. The curved lines in Fig. 3 show the direction of the wind. The air is drawn to the centre of the circle where the barometer is lowest, and the path becomes more circular as its velocity increases, and finally it whirls round with hurricane force. At the centre is the calm spot from 10 to 30 miles in diameter, the diameter of the whole area represented being from 100 to 800 miles, being generally less in low latitudes. The direction of the wind at any point on the diagram is the same as the direction of the curve at that point, and the arrows show the direction at the points where they are plotted. By placing arrows at all points having the wind in the same

direction—north, for example—and joining them by a dotted line, we find that the line curves in towards the centre as shown. This line being nearly straight in the inner whirls, a ship sailing before the wind would have the centre of the storm on her left at right angles with her course, "full a-beam," or eight points on her port quarter. This is the well-known eight-point rule. The angle of bearing is about ten points at the margin.

(To be continued.)

SOME SEVERE WINTERS.

ALARMING accounts have reached this country from America of the severity of the weather during this present winter. Not that the temperature was so exceptionally low in comparison with former severe winters; but that the drifting snow was so fine and flour-like that travellers were literally suffocated by the clogging of the lungs through breathing the powdery snow. Many children perished on their way from school in several places, as the storm suddenly attacked them after they left for their homes. But, according to an old work written in 1788 by a German, H. Pilgrino, who resided at Vienna, some winters in Europe were exceptionally severe.

The southern parts of Germany and the region of the Alps and Scythia were much colder some centuries ago than they are now. Still rude Boreas occasionally gives the more temperate regions a taste of Arctic bitterness. In 401 the Black Sea was entirely frozen over. In 462 the Danube was frozen, so that Theomedor marched over the ice to avenge his brother's death in Swabia. The cold in 545 was so intense that the birds allowed themselves to be caught by the hand. The snow in 763 rose in some places 50 ft. high; and the ice was so heaped in cities as to push down the walls. In 822 the great European rivers were frozen so hard that heavy wagons were on them for a month. The winter of 874 was very protracted, the snow continuing to fall from the beginning of September to the end of March, and covering the ground so that fuel could not be obtained from the woods. In 891 cattle perished in their stalls from the intensity of the cold. So severe was the cold in 1007 that travellers in Germany were frozen to death on the roads. In 1133 wine casks were burst, and trees were split with a loud noise by the continued action of the frost. The crops and vintage of Austria were destroyed in 1179, the snow continuing to the depth of 8 ft. until Easter. In 1236 the Danube remained frozen to the very bottom for a considerable time. The winter of 1269 was most intense in Scotland; and the ground all over was quite bound up. In 1281 such a quantity of snow fell in Austria as to bury the houses. Eleven years afterwards 600 peasants in Germany were employed to clear away the snow for the advance of the German army. In 1339 the crops in Scotland failed; such a famine ensued that the poorer people were reduced to feed upon grass. In 1408 the vineyards and orchards of France were completely destroyed. The winter of 1468 was so severe in Flanders that the wine distributed to the soldiers had to be cut in pieces with hatchets. The Scheldt froze so hard in 1564 that it supported loaded wagons for three months. In 1621 the Venetian fleet was blocked up in the lagoons of the Adriatic. It was in 1658 that Charles X. of Sweden crossed the Little Belt, over the ice, from Holstein to Denmark, with his whole army, foot and horse, followed by a train of baggage and artillery.

The oaks of England were split up by the frost of 1684, which also destroyed most of the wild birds. In 1691 the cold was so excessive that the famished wolves entered Vienna and attacked cattle and even men. The famous winter of 1709 went by the name of "the cold winter"; then all the rivers and lakes, and even the seas, of Europe were frozen to the distance of several miles from the shore. Where the ground was bare the frost penetrated to the depth of 9 ft. Birds and wild beasts were strewn dead upon the fields, and men perished in thousands in their houses. All the tender shrubs and vegetables in Britain were killed, and wheat was doubled in price. Twenty years afterwards the frost lasted in Scotland from October to May, when multitudes of cattle and sheep were killed, and many of the forest trees were destroyed. In 1739 the thermometer at Leyden registered 42° of frost; and the General Assembly of the Church of Scotland ordained a national fast to be held, on account of the dearth which then prevailed in consequence of the intense cold. In 1776 wine was frozen in the cellars of France; many people were frost-bitten; and vast multitudes of birds and fishes perished.

From the Transactions of the Royal Society of Edinburgh, we find that in 1783, the winter of "remarkable cold," Professor Wilson, of Glasgow, registered 44° of frost on the surface of the snow. In 1824 the son of a celebrated Radical, Henry Hunt, drove for a wager his father's blacking-van, drawn by six horses, across the ice of the Serpentine in London. During several winters fairs were held on the ice of the Thames. Even in 1838 the thermometer of a careful observer in Perthshire, Scotland, registered 40° of frost (Fahr.), when, it is stated in his statistical account of the parish, that in a bedroom where constant fires had been kept up for ten nights and days previously, water spilt on the ground almost instantly congealed. In 1882 we observed in Perthshire 38° of frost; and in a room where there was no fire the ink was frozen. Still, the exceptional beauty of the hoar-frosted trees, glistening in the sun, and with prismatic power refracting the rainbow colours at every point, partly compensated for the inconvenience occasioned by the continued cold.

THE PHOTOGRAPHIC EXHIBITION AT THE CRYSTAL PALACE.

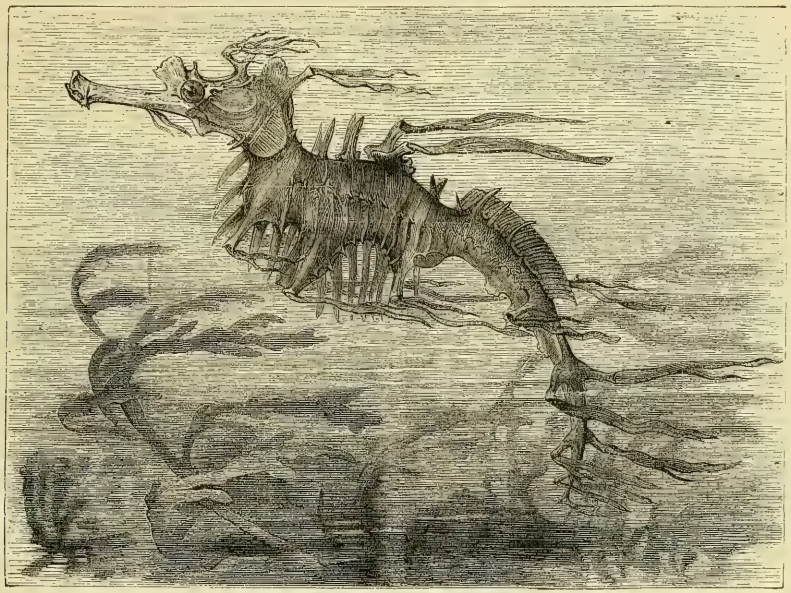
THE collection of apparatus and photographs opened at Sydenham on the 20th ult. is one of the best we have seen. Owing to the pressure on our space, we can only refer to some of the more novel and interesting exhibits. Amongst them is a single lens, made by Dallmeyer, which is said to be entirely free from distortion, and a lens, by the same maker, with an ingeniously contrived instantaneous shutter between the two combinations. Messrs. J. H. Steward exhibit Chapman's self-acting valve for compressed gas cylinders, a clever arrangement for keeping constant the pressure of the gas escaping from the cylinders. The same firm show a triple projection lantern provided with an arrangement for centering the three pictures on the screen, and also with an automatic arrangement for turning on or off the gas supply. Messrs. Hilton and Co. bring forward some stoppered bottles with raised glass labels, which should be of great service in the dark room and laboratory.

Amongst the transparencies we observed a splendid educational series prepared by the Sciopticon Company, and amongst the prints were many interesting instantaneous photographs.

Natural History.

PHYLLOPTERYX.

Of the whole family of Pipe-fish (*Syngnathidæ*) few are more extraordinary in appearance than those belonging to the genus *Phyllopteryx*. Several species of the family are provided with short cutaneous appendages, disposed more or less symmetrically about their bodies, but in no case are they developed to such an extent as in the species which may be referred to this genus *Phyllopteryx* (Kaufs). The first of these curious pipe-fish was fully described and sketched by Shaw (Zool. v. pl. 180), who called it *Syngnathus foliatus*. Lacépède, in the same year, also mentions this species, which he calls *S. Taeniopterus*. As, however, Shaw's work was written some time before the memoir of the latter author, the first of these names lays claim to priority and is generally accepted. The British Museum (Natural History Collection, South Kensington) has a fine specimen of this *P. foliata* from Tasmania, 13½ inches long, and in the collection of drawings made by Ferdinand Bauer, Dr. Brown's companion during Capt. Flinder's voyage, there is a finely coloured sketch of another specimen. The second species was described by Dr. Grey in 1859 as *Haliichthys Taeniophora*. It was in a collection made by the medical officers of H.M.S. "Herald," having been found in Freycinet harbour, Shark's Bay, W. Australia. Its head was compressed with a high-arched central ridge armed with spines, and with protruding eyes with large curved spines on the upper edge of the eyebrows, its body six-sided, covered with scales forming about nineteen rings, each ring armed with spines, those of the three or four largest rings being furnished with long ribbon-like appendages. The tail was four-sided, the under side the widest and comparatively flat, the other three concave; the caudal rings were about forty-five in number, and all bore spines, most of which had filaments like those on the body. The dorsal fin was 26-rayed. The dried fish was black above, pale-coloured beneath; on each side of the body there were three distinct black spots, and on the under side of the base of the tail several distinct black cross bars. A third species, of which we give an illustration, was presented to the British Museum in 1865 by Mr. George French Angas, who received it from Port Lincoln, South Australia. This was named *Phyllopteryx eques* by Dr. Albert Günther, who contributed the following description of it to the journal of the Zoological Society in the same year:—"Spines, crest, and cutaneous appendages strongly developed, and trunk elevated into an upper and three lower prominences. The snout bears a pair of small spines behind the edge of its upper margin, a pair of minute barbels at the chin, and a pair of long appendages in the middle of its lower part. The forehead bears an erect, broad crest, and a cluster of spines with narrow appendages on the occiput. Nape of the neck with a long spine dilated at the base into a crest and carrying a long bifid appendage. The trunk is strongly arched on the back, and has two deep indentations on its lower profile. The tail is quadrangular with sharp edges, and with five pairs of band-bearing spines along its upper edge. Dorsal fin is entirely on the tail. The colour is probably red in life." There is no pouch developed in this species, as in some of the pipe-fishes, the ova



Phyllopteryx Eques (Günther).

being embedded instead in a soft membrane on the lower side of the tail. The tail is slightly prehensile, and acts as a kind of anchor, by means of which the Phyllopteryx attaches itself to seaweed, drifting spars, etc. Dr. Günther was the first to call attention to the remarkable resemblance of this fish, with its curved body and long appendages, to the seaweed of the Australian seas, a resemblance which not only enables it to obtain the small worms, etc., which form its food more easily, but also affords it a most efficient protection from its enemies.

THE EARTH-WORM AS THE INTERMEDIATE HOST OF SYNGAMUS TRACHEALIS.—It is a not uncommon occurrence that a parasite inhabits different animals at different stages of its growth. This is the case with the small thread-worm *Syngamus trachealis* which infests the windpipe of the pheasant, peacock, turkey, duck, and other fowls, and often occasions considerable damage. Mr. Walker, of Franklinville, New York, has recently made some investigations on this subject. He finds that the intermediate host of the embryo *Syngamus* is the common earth-worm, which in places visited by birds has been found to be beset with these parasites. They are swallowed by the birds along with the worms, and perforating the œsophagus, find their way into the respiratory organs. During, or immediately after, this migration the *Syngamus* attains sexual maturity, and attaches itself to the trachea. This happens in six or seven days after it has been swallowed. In seven days more its eggs are produced, which are coughed up by the bird, and reach the ground, where the embryo emerges in about three weeks. It is swallowed by a worm, and remains in its intestinal canal until devoured by a bird. The best method to check this disease is to moisten the soil with brine, which kills both the worms and the embryo *Syngami*, which they contain. Birds which have died of this disease should be destroyed by fire.

THE POISON OF THE YEW.—M. Marcelin, writing in *Cosmos*, gives an account of the poison of this tree. The bark and the wood, if dangerous at all, are not perceptibly so; the flowers and the berries are also innocent, since the thrushes feast upon them eagerly. The poison seems to be concentrated in the leaves, especially when old. A horse has been killed by eating 650 grammes of the leaves. The goat requires, in proportion to its weight, six times as much as the horse. The ass and the mule are very sensitive, and man is probably more so. Death ensues suddenly in an hour or two after the poison has been swallowed, occasioned by its action on the nervous centres. No lesion is found on the autopsy of the animal.

THE POISON OF THE LABURNUM.—This well-known and beautiful tree (*Oytisus laburnum*) contains in its bark, its flowers and its pods a violent poison, which ultimately disappears from the green parts and accumulates in the seeds. According to Prevost and Binnet, the laburnum is a good emetic, which acts with peculiar rapidity if the watery extract is injected subcutaneously. In large doses it occasions paralysis of the central organs similarly to curare, though less powerfully. According to Carnevin, the internal administration of this poison is not fatal to animals which can vomit, such as dogs and cats, as it is quickly rejected. Horses or asses, which can not vomit, readily succumb. He maintains that the ruminants, though unable to vomit, resist this poison.

HYBERNATION.—Two dormice (*Myoxis glis*), which were observed by Ford (*Revue de l'Hymotisme Experim.*), remained the winter through awake and very brisk. They began their sleep in May, and awoke early in August, notwithstanding the great heat in June and July. Hence the winter sleep does not depend directly on a decrease of external temperature. During hybernation the temperature of their bodies was from 68 degs. to 71 degs., Fahr. The respiration was abnormally slow, and the lips took a bluish colour. If the animals were disturbed, there ensued some reflex movements, and a faint grunting was heard. Ford regards the hybernation of dormice as very similar to hypnotic sleep.

THE MUSCULAR SENSE.—In order to study this subject M. Beaunis (*Revue Philosophique*) applied cocaine to the mucous membrane of the larynx of a vocalist, whilst the aperture of the glottis was rendered non-sensitive to contact, the capacity for producing sounds correctly, was not affected. It is, therefore, not the sensitiveness of the mucous membrane which indicates the state of tension of the vocal cords required for the production of any given tone. He considers that this is effected by the sensitiveness of the muscles themselves.

THE DENTITION OF THE RODENTS.—Mr. E. D. Cope (*American Naturalist*) shows that nearly all the peculiarities of the dentition of rodents (rats, mice, rabbits, etc.) are the mechanical consequences of an increase in the length of the incisor teeth, and the increase in the length of these teeth has been due to their continued use.

PHOSPHORESCENT INSECTS.—M. H. G. de Kerville has recently produced a monograph on this interesting subject, from which it appears that the luminous tissue is of a fatty nature, that its constituent cells are the seat of an active exchange of matter, that it contains a substance analogous to guanine, and a multitude of small crystals. The nervous system intervenes only as a regulator by animating special muscles, which in turn act only by regulating the afflux of blood. We have in it, in short, a physico-chemical phenomenon, more or less modified by the general conditions of life.

ODORIFEROUS ORGANS IN INSECTS.—W. Müller, of Griefswalde, has detected scent organs in the *Phryganeidæ*, and especially in *Sericostoma personatum*, similar to those which are met with in male butterflies as lures for the females. The organs are formed of an exaggerated growth of the palpi of the under jaw (maxilla). When the animal expands the spoon-shaped portion an odour like that of vanilla is distinctly perceptible.

THE LUMINOUS MATTER OF PHOLAS DACTYLUS.—This destructive mollusc secretes from its mantel and syphons a mucus which shines in the dark. R. Dubois (*Comptes Rendus*) has discovered that its luminosity does not depend on the vital activity of the animal. On drying the mantel the emission of light ceases, but reappears, even after a long interval, if the specimen is steeped in water. All reagents which coagulate albumen at once suppress the light. Dubois has isolated from the luminous tissues two substances which emit light as soon as they are mixed together in solution. They are *luciferine* and *luciferise*, the latter being probably a soluble ferment.

TECHNICAL EDUCATION.

ABRIDGMENT OF PAPER READ AT THE SOCIETY OF ARTS BY MR. SWIRE SMITH ON THE TECHNICAL EDUCATION BILL.

IT is a remarkable fact that, although for ages past it was considered necessary that our professional classes should go through prescribed courses of scholastic training in order to prepare them for their subsequent occupations, there was no such appropriate training considered necessary or offered to the commercial and industrial classes of the United Kingdom. For our lawyers, doctors, divines, literary men and others, the public schools and universities of the country, with their magnificent endowments—intended in many instances for the education of the poor—have supplied great opportunities and advantages of special training, but there have been no schools until recently, either public or private, which offered, even in a remote degree, scholastic training suited to the requirements of the engineer, merchant, manufacturer, farmer, or skilled artisan, the men upon whom the development of the resources and the material prosperity of the country really depended.

And in most instances, when the necessity for such training was urged, its advocates were denounced as men who would degrade education into mere utilitarianism. It has only been since a number of rude blows have been struck at our commercial supremacy by some of our highly-trained manufacturing rivals in other countries, and since our great agricultural industry has been almost paralysed by the competition of the outsider, that public attention has been drawn to the question of education in its relation to the industrial and commercial requirements of our people. In fact, it may be said that it is almost entirely in its relation to foreign competition, both as to manufactures and agriculture, that the question of technical instruction has been brought to the front in this country.

A Royal Commission was appointed, and in proceeding with our enquiry, we considered it necessary to inform ourselves as to the nature and extent of the foreign competition from which the several industries in this country were suffering, and in order to satisfy ourselves upon all points of detail, we visited the leading industrial districts in the United Kingdom; we inspected factories and workshops, and received evidence from representative men in each industry as to the causes which, in their opinion, promoted or retarded the prosperity of the many branches of British commerce. We also visited many of the schools and classes in this country, in which the theoretical training of employers, foremen, and workmen had been received.

Having ascertained the origin of the various foreign manufactured products which were displacing those of the United Kingdom in our own and neutral markets, we visited the manufacturing countries of Europe, and through the courtesy of foreign employers, inspected many of the great industrial establishments of our competitors. With all the details of the processes of manufacture before us, we traced, as far as possible, each advantage of our rivals in superiority or cheapness to its source. We visited the schools in which employers, foremen, chemists, designers, and art workmen had received their theoretical instruction, and, as bearing indirectly upon our inquiry, we took every opportunity of obtaining information as to the rates of wages and hours of labour, the influence of piecework, division of labour, protective duties, the military systems, and other conditions which, in each Continental state, more or less affect the cost of production and the quality of the manufactures.

Our inquiry showed very clearly that the modern manufacturing systems of every country are modelled on those of England. In many instances we found that factories had been designed and furnished throughout by English machine makers, while many foreign manufacturers had been taught their trades by Englishmen. All the best machinery that we saw was English, or had been copied from English, and this applied to most of the machine tools in foreign workshops.

In matters of organisation, labour-saving appliances, etc., our imitators have followed us so closely that the best continental factories approach very nearly to our own. The proportion of modern new works to the whole in each industry is greater in Germany and some other countries (particularly in the United States and Canada) than in England, where there are many large establishments in which large fortunes have been made, but which are not equipped in the best and most economical style for the competition of to-day. In the outward conditions apparent to the eye the advantages of economy of production often appeared to be in favour of the foreigners, but in nearly all the cases in which we were enabled to sift the evidence, the real advantages were on the side of this country. There were important exceptions to this rule, and in noting the rapid strides that have been made, and taking account of the long hours and the low wages of continental operatives as compared with our own, it did seem that in the production of staple goods and metal work of various kinds, we are within measurable distance of being equalled, if not surpassed, "all along the line" by our most advanced rivals, assuming that other existing conditions remain unchanged.

This country, as everybody knows, has made its wealth and formed its "connexion" by the manufacture and export of "goods for the million." We have never been famed in the past for the artistic qualities or taste of our machine-made productions, and in truth, in the prosperous times some years ago, there was but little temptation to trouble about the making of new patterns so long as the machinery could be kept going at a profit on the old ones. But a change of immense importance has come, as I will briefly explain. The English foremen who accompanied English machines to other countries first taught the foreign manufacturers and operatives to make such goods as were being made in English factories, viz., the goods for the million. Favoured by cheap labour, long hours, and heavy protective duties, each country began to supply its own markets with the products which had hitherto been imported from England. It has been said that for every English machine that was started in France, Germany, Belgium, Austria, Russia, and in the United States and Canada, a similar machine employed in England on goods for those countries was displaced. By such means we lost some important branches of our export trade in common staple goods, of the value of many millions of pounds sterling annually, and this fact in itself accounts for much of the commercial depression from which this country during recent years has so seriously suffered.

It is, however, in our import trade that our weak points as manufacturers are most seriously exposed.

While our exports have suffered curtailment, the more advanced of the Continental countries have not only supplied their own markets with common goods, but have opened up a most important export trade in attractive goods and novelties which not only supersede British goods in neutral markets but find their way in ever-increasing quantities to our own. To put the case briefly, I may say that the Technical Commissioners, in conducting this branch of our inquiry, ascertained that our imports of foreign manufactures, with some exceptions, were not due to the longer hours and the lower wages of foreign operatives, as is generally supposed, but to the superiority, attractiveness, or novelty of the goods themselves.

We discovered, often to our great surprise, English machines in foreign countries producing more effective, more attractive, and more saleable goods than were being produced by English machines in competing establishments in this country. In the second place, we found that the special qualities which promoted the sale of foreign products, so largely imported by the people of this country, were due to the scientific or artistic training of employers, foremen, designers, chemists, or workmen, in the establishments where the goods were produced. In every industry in competing countries abroad, those persons who are responsible for the designing, shaping, finishing, colouring, or making up of a fancy article, whether it be in metal work, pottery, furniture, or a woven or printed fabric, have almost invariably received some training in art or science, or have gone through a special technical school. In England, the majority of persons holding similar positions have received no artistic or scientific training whatever, except when, as often happens, those positions are held by foreign designers or chemists, or by Englishmen who have been trained in foreign countries.

And if we discovered that one of the chief causes of our deficiency in the production of saleable commodities was to be found in our lack of scientific or artistic training, we discovered also that the superior "methods of commerce," on the part of some of our neighbours, was equally due to their more appropriate scholastic instruction. The foreign correspondents in the merchants' offices in our large towns, who are employed because Englishmen of equal linguistic ability and training could not be obtained; the foreign agents and travellers from Germany and other countries, scattered all over the world, pushing the business of their respective firms and countries, have qualified for their positions by a commercial training which has hitherto been almost inaccessible to the Englishman.

It is sufficiently humiliating to be compelled to acknowledge that, in the industrial contest of to-day, English machinery is being employed to better and more profitable account by some of our rivals than by ourselves; but it is infinitely more serious and more humiliating to find that in the conditions of training which best tend to promote future efficiency and success, the rising generations of other countries are being far better prepared than those of England.

I believe that by carrying into operation a Technical Instruction Bill, wise and just in its provisions, applying to agriculture as well as to commerce, meeting the wants of the artisan, the foreman, the commercial man, the employer, and taking effect in every parish in the country, new vigour and force will be given to our British industries, and the well-being and prosperity of the nation will be materially increased.

In considering this question, we must keep clearly before us the fact that our aim is to develop, through a more highly cultured people, our industrial system: to regain of our commerce what we have lost; to retain and improve that which we hold. In so much as education can help in this movement, then education must be supplied, and with no niggardly hand. We have to cope with countries which have organised their education as thoroughly as they have organised their military systems, and with the same regardlessness of cost; indeed, they have found that the union of scientific knowledge with practice, which forms the best equipment of nations in the arts of war, also forms their most formidable equipment in the arts of peace.

In suggesting a programme I go far beyond the Technical Instruction Bill of the Government, which was submitted to the House of Commons and withdrawn after passing its second reading last Session.

Briefly, the object of the Bill was to enable a local authority—a School Board, or Council of a Borough where there is no School Board—to supplement by technical instruction the elementary education supplied in its district. Power was given to each district to provide technical schools out of the local rates; to combine for the purpose with any other local authority, or to contribute to the maintenance, or provision and maintenance of any technical school with the sanction of the Science and Art Department. The conditions required were that each scholar receiving local aid should have passed the Sixth Standard of the Education Code, and that each school provided under the Act should be conducted in accordance with the minutes of the Science and Art Department, which were to be fulfilled by such a school in order to obtain a grant from that Department.

To provide for objections on the part of ratepayers, power was given, under clause 3 of the Bill, for opposition to its adoption by a written requisition of fifty ratepayers demanding a poll of votes of the locality. This clause, however, did not apply to the metropolis, nor was it included in the Bill for Scotland.

The term "Technical Education" was defined as instruction in the branches of science and art with respect to which grants are or may be made by the Science and Art Department, and I propose to adopt the same term in my own suggestions which follow.

I will not comment upon the Bill, further than to express a hope that the provision for a poll of the ratepayers—which seemed to have been inserted in order to tempt localities to refuse to carry it into effect—will not appear in the new Bill.

In order to bring our system of education into harmony with the immediate wants of each locality, and to enable our people, consistently with our national habits, to obtain such technical training as will materially help them in the practical work of life, the following educational provisions are necessary:—

First, as to Elementary Education—under School Boards and voluntary school managers.

1. *Infant Schools.*—The introduction of the Kindergarten methods of instruction should be everywhere encouraged, as tending to the development of skill and observation on the part of the children.

2. *Elementary Schools.*—

(*a.*) That drawing be taught universally to boys and girls, and that the teaching of modelling be encouraged by grant.

(*b.*) That the teaching of elementary science be encouraged in the upper standards.

(*c.*) That for the better teaching of drawing, modelling, and science, every school be furnished with appropriate models, casts, and examples, suitable to the requirements of the scholars of each locality.

(*d.*) That grants be made to schools in aid of collections of natural objects, casts, drawings, etc., suitable for school museums.

(*e.*) That in connection with each elementary school, or group of schools, a room be fitted up as a workshop, with provision for the instruction of every boy in the use of simple manual tools during his last year of schooling, and that a grant be made upon workshop fittings and tools, and upon the instruction, in accordance with regulations to be made by the Education Department. This instruction to be given out of school hours if possible, and factory half-timers to be exempted from it if considered desirable.

(*f.*) That in agricultural districts the use of tools and the facts of agriculture be taught to boys, and that, where possible, garden plots be secured for practical instruction.

(*g.*) That in addition to drawing and needlework, the elements of cookery and household management be taught to all girls in the upper standards.

(*h.*) That Government grants on drawing, elementary science, the use of tools, and cookery, be sufficiently large as to encourage teachers and managers to give due attention to these subjects.

(*i.*) That children should not be allowed to work as full-timers under fourteen unless (as in Scotland) they have passed the 5th Standard. That this regulation be subject to the following exemption, viz. :—That attendance in an evening continuation school for one year—subject to the restrictions as to regularity of attendance and presentation at the examination under H.M. inspector—be allowed as an equivalent to half-time attendance at a day school between thirteen and fourteen.

Beyond the above simple provisions, which would not seriously affect the existing arrangements, or entail much extra cost upon the country, it does not appear necessary at present to introduce technical instruction into elementary schools.

(*To be continued.*)

MAGNETIC SEPARATORS.—An interesting application of magnetism has been made in connection with the manufacture of pottery. In crushing the hard, flinty, raw material, considerable difficulty has been met with, by reason of the great wear and tear of the iron rollers, between which the material is passed, and the latter becomes so highly impregnated with iron as to be almost valueless. To remove this iron from the extremely fine dust or flour into which the flint or spar is ground, a machine has been devised with a series of electro-magnets, across the face of which the material is made to pass, the iron dust being retained. It is said that, in one instance, when a specially-prepared mixture was used, over seventy-five per cent. of the iron was extracted at one passage through the machine.

ELECTRIC LIGHTING IN GERMANY.—It is estimated that there are at present in use in Germany 15,000 arc lamps and 170,000 glow lamps, supplied with current from about 4,000 dynamos. On the assumption that an arc lamp requires on an average ¾ h.p. and a glow lamp ⅓ h.p., the total horse power employed in electric lighting throughout Germany amounts to 30,000 h.p. In Berlin alone there are 1,554 arc lamps, 22,363 glow lamps, and 333 dynamos installed. These statistics show that electric lighting is already much in favour in Germany.

SNOW, AND THE FORMATION OF HUMUS.

IN the Bavarian Highlands the peasants have a proverb that "snow is manure." This applies chiefly to the Alpine meadows, and illustrates the fact that surfaces of turf just freed from the winter's snow display a peculiarly luxuriant growth. Indeed, mountain snow, even if not very old, yields on melting a dark-coloured residue, half of which, and even more, consists of organic remains, fragments of pine-needles, leaves of the Alpine rhododendron (*R. ferrugineum*), bark, rosin, wood, bast, moss, algae, fungi, pollen, seeds, hairs, wings of beetles, etc. Even a small patch of snow, not containing more than 1,000 cubic metres, and situate at the altitude of of 1,800 to 2,200 metres has been known to yield on melting more than 1 kilo of dry matter, more than one-fourth of which was of organic nature (*Deutsch und Oesterr Alpenverein*, 1887, reproduced in *Humboldt*).

The inorganic portions of this residue contain as much as 32·4 per cent. oxide of iron. Whether this fact is connected with the hypothesis of Nordinskiold on the deposition of cosmic meteoric dust, the chemists and mineralogists must decide. Doubtless an examination of the snow-sediments would not fail to lead to interesting results. The organic matter has chiefly been brought by ascending currents of air, and caught by the snow, and thus secured from being scattered further. We must not overlook the organic masses produced by the Alpine vegetation of *Protococcus nivalis*—commonly called red snow—which often extends for miles, and penetrates deeply into the snow-fields, as well as the remains—often innumerable—of glacier fleas. The remains of other insects form occasionally an important article of diet for the snow-daws. Schultz could scarcely find upon the ice-fields a square inch upon which there were not to be seen several gnats and flies. Snow which has remained for a year betray these foreign admixtures at a distance by its perceptibly dirty colour. The coarser of such impurities lie on the surface; the finer particles sink down through the snow with the water as it melts out, and are deposited at the bottom as a very fine sediment, soft to the touch.

Sometimes beneath hollow masses of snow which are melting rapidly the mud forms dense ridges or heaps, which remind us of the casts of worms, and which may contain as much as 75 per cent. of organic matter. Where a snow deposit has been lying immediately upon ground covered with vegetation, the sediment adheres closely to the latter, and enriches it with finely divided matter, which contains a proportion of organic matter, exceeding the ordinary amount in humus soils.

The upward extent of vegetation in the more elevated parts of the Alps, as compared with the bareness of the more elevated parts of the Appenines, the southern portion of the Sierra Nevada of California, the Lebanon, and other mountain ranges not covered with perennial snow, to which the fine dust may adhere, is to be explained by the action of the snow in forming humus. The profusion of humoid earth in the Alps, in regions where scarcely a green blade grows, is one of the most remarkable phenomena. The ordinary soil of the Alpine meadows contains from 16 to 20 per cent., but the black, fatty soil of the upper regions in parts contains more than 60 per cent. of organic matter. The moorland character of the high mountain flora is easily intelligible on soils of such composition.

Reviews.

Report of the Committee of Council on Education; England and Wales, with Appendix. 1886-87. London: Her Majesty's Stationery Office.

We have here a bulky volume rich in statistics. From it the public will learn that the elementary day-schools under Government inspection provide accommodation for 5,145,292 pupils, and have on their books the names of 4,505,825. Whilst the population of the country has increased by 1·35 per cent., the school accommodation has risen by 2·93 per cent., and the scholars on the register by 2·12 per cent. We note the curious remark that "the local effort which has resulted in this improvement may be measured by the diminished support derived from voluntary contributions, and by an advance in the contributions from rates for the maintenance of board schools." It appears that in voluntary schools the average cost per scholar is £1 16s. 4½d., that in board schools it is £2 4s. 11¾d. The accommodation in voluntary schools has increased since 1870 to the extent of 1,574,203 seats, and in board schools to that of 1,692,505. Six million pounds, without Government aid, have been spent on the erection or enlargement of voluntary schools.

The school-boards, we are told, have freely availed themselves of their power of contracting debts on the security of the rates, and have thus involved their respective districts to the extent of about nineteen million pounds.

The actual supply of school accommodation is in excess of the calculated number of children of school age. Nevertheless the Committee think that a new school for 1,000 children ought to be opened in London every month for ten months in the year; a bright prospect for the ratepayer! In England the average annual rate is 7d. per £, but in London it has reached 9d.

But whilst the volume before us is well stored with facts, it throws little light on the future intentions of the Education Department, and on the prospects of improvement. The Committee make no mention of a variety of questions which exercise the public mind. Such, above all others is the desirability of transferring the control of education from themselves to a Minister of Education, directly and individually responsible to Parliament. Such too are several points in connection with technical education. Is a training in applied science to be extended to all children, or only to boys who are found to possess especial aptitude? Are technical schools to be supported out of the rates, and governed by the local school boards? Again, is the principle of "free education" to be encouraged, and are the children to be fed as well as educated at public expense? In other words are "free dinners and examinations" to be substituted for the *panem et Circenses* of imperial Rome in her decline? Lastly, but not least, is the system of "payment of results" (so-called) to be still maintained? On this head we note a brief but significant passage in Mr. Blakiston's General Report for 1886 (p. 271): "So engrossed is the common-place teacher with the financial outcome of every item of school work that he is apt to forget that his main duty is to develop the higher faculties of his scholars, not to prepare them to earn grants, or to swell the percentage of passes." Who can fail to see the moral?

Thorough Cultivation. By Sir A. Cotton.

This instructive little book labours under a deficiency which is, in our experience, unique. It bears no name of any publisher, bookseller or printer, nor is it said to be a reprint from any paper or from the transactions of any society. In consequence we cannot recommend it as we should wish to do. The author shows that the soil of England could, under attainable conditions, produce food enough even for her present crowded population, and could, in so doing, provide work for the "unemployed"—that is, if willing to work. An additional benefit would be the cessation of that inrush of our population to the cities, which is simply a case of congestion as dangerous as any occurring in the human body.

Nottingham Naturalists' Society. Transactions and Thirty-fifth Annual Report, 1887. Nottingham: J. Ellis.

We are glad to find that this society is not losing ground, though the council conclude that it does not perform its true functions as a Natural History Society so completely as could be wished. They recommend the formation of sub-sections for the better prosecution of work in various branches of natural science. We suspect that the members have before them a fairly good scope for local work. We believe that the fauna and flora of Sherwood Forest have not yet been as thoroughly investigated as would be desirable. Even in the mere point of localities we are not yet able to map out the haunts of every plant, insect, mollusc, etc., in this small country in connection with temperature, altitude, soil and geological character. Our provincial societies may, if willing, take an honourable share in this vast investigation.

We perceive that one of the monthly meetings of the society is generally devoted to an exhibition and inspection of microscopic specimens, whilst at the other a paper is read. Four of these papers are here published; on "Glaciers and Glacier-action," by E. J. Bedford; on "Spontaneous Generation," by E. Kidson; on "Smell and Taste," by W. J. Abel; and "Notes on the Flora of North Notts," by Rev. Hilderic Friend. All of these are worth reading.

The society offers prizes of £1, 10s., and 5s., respectively, for the three best collections of wild flowers, land and fresh-water shells, rocks and fossils, and butterflies, moths, flies, beetles, etc. The specimens must have been obtained within the five counties, Nottingham, Derby, York, Leicester, and Lincoln, and between April 1st, 1887, and April 30th, 1888.

We notice that there exists also in the same town a "Working Man's Naturalists' Society." As far as we can judge, in the absence of special information, these societies would prove more efficient if fused into one.

The Eskimo Tribes: their Distribution and Characteristics, especially in regard to Language; with a Comparative Vocabulary and a Sketch Map. By Dr. Henry Rink. Copenhagen: Reitzel. London: Williams and Norgate.

The author of this work does not attempt to decide what must be regarded as the main question, *i.e.*, whether the origin of the Eskimo race was in America or Asia? He goes back no further than the beginning of the dispersion over the territories which they at present occupy, that is from the extreme north-east of Asia along the north-west and north of America as far

as Greenland. He does not seem to have taken their close structural approximation to the Japanese into account. Within the limits which he has marked out for his inquiry he considers that the original home of the Eskimo was in the interior of Alaska. He describes at some length their chief means of earning subsistence, namely, their peculiar boat, the kajak, their double-bladed paddle, and the large harpoon with bladder and line, showing that these instruments display much ingenuity and have probably undergone a prolonged development. He next gives an account of their dwellings, their dress and ornaments, their religion and folk-lore, and their social organisation. He shows, contrary to the opinion of some traders and missionaries, that they have traditional rules or laws and chiefs or leaders, who know how to inforce such regulations. He denies that absolute equality exists in any human race, and he quotes from Mr. Gilbert Sproat, the explorer of Vancouver Island, the query:—"Was Darwin long enough among the Fuegians to be enabled authoritatively to affirm that perfect equality exists among the individuals composing the Fuegian tribes?" We shall the rather agree with the author if we reflect that even communities of baboons have their chiefs.

The relations between the Eskimos and the Red-skins are amicable in the west, but further eastwards, as on the borders of the Mackenzie River, the two nations are decidedly hostile.

The greater portion of this book is devoted to a comparison of the various Eskimo dialects—a subject likely to be of interest only to the philological specialist.

Flower-Land: An Introduction to Botany for Children and for the Use of Parents and Teachers. By Robert Fisher, M.A., Vicar of Sewerby, Hull. Manchester and London: John Heywood.

Here is a little manual in which, within the compass of 62 pages, may be found a clear, plain explanation, not merely of the most important botanical terms, but of the leading features of plants and of the broad outlines of botanical classification. All this is presented in language which is not merely simple and unpretentious, but decidedly pleasing. As a first step for children in the study of things, and as a guide to the much-neglected art of observation, this work is most strongly to be recommended.

The Stevens Indicator. Vol. V., No. 1, January 15th, 1888.

Much of the matter in this number is of too purely technical a character for discussion in our columns. In an article on "Teaching Mathematics" we find the suggestive remark that "Ideas always disagree—first, on the vast question of *What is to be taught?* and after that is settled, there is a further unanimous disagreement on the equally vast question of How shall it be taught?

The use of "Windmills for Generating Electricity" is considered by Mr. A. R. Wolff. The author shows that "with well-constructed windmills a practically uniform rate of revolution is obtained, irrespective of the direction and varying velocities of the wind, for all winds exceeding a velocity of six miles hourly." He mentions that total calms in excess of two days' duration are practically unknown in the United States.

The "Influence of Sugar upon Cement" is discussed by H. de B. Parsons, who finds that the influence of sugar on cement is more mechanical than chemical. By its presence it simply retards setting, and thereby enables the chemical changes in the cement to take place more perfectly.

Elementary Physiography. By John Thornton, M.A. Illustrated. London: Longmans, Green, and Co. 1888. Price 2s. 6d.

This little book is one of Longmans' Elementary Science Manuals, and is well worthy of its place in that excellent series. Mr. Thornton treats his subject, which the Germans call *Erdkunde*, with a breadth and comprehension quite unlooked for in so small a work. The chapter on the sea is especially interesting, for it embodies much new knowledge gained by the '*Challenger*' Expedition. There are ten good maps and many illustrations. There are also the Examination Papers set in this subject by the Science Department of South Kensington for the last four years, and there is an excellent index. The book, though primarily intended as a text-book for the Science Department's Examinations, forms for the general reader an interesting introduction to the study of physiography.

Transactions of the Institution of Engineers and Shipbuilders in Scotland.

At the meeting of this Institution on January 24th, 1888, Mr. G. C. Thomson, F.C.S., read a paper on "Copper and Copper Castings," showing the deterioration of the metal from the absorption either of oxygen or carbon.

Mr. Nisbet Sinclair read an account of "Experiments on the Strength of Copper Steampipes (page 3) made at Lancefield."

Mr. R. Simpson, B.Sc., C.E., introduced a discussion on the "Construction of the Glasgow City and District Railway." Mr. A. S. Biggart described the erection of the superstructure of the Forth Bridge; and Mr. Liddell exhibited and explained a model of Chambers' New Unsinkable Semi-collapsible Lifeboat.

EDUCATIONAL BEQUESTS.—The trustees under the will of the late Mr. E. R. Harris have just concluded the disposal of upwards of £285,000, which the deceased gentleman bequeathed to the town of Preston "for purposes of public utility." Of the bequest the trustees have granted £105,000 for the founding of an institution to be called "The Harris Free Library and Museum," £75,000 of this amount to be devoted to building purposes, £15,000 to endowment, and £15,000 to the purchase of reference-books, works of art, &c. The actual building operations are now completed, and the formal opening will take place at the end of this year or the beginning of 1889. To this building will be removed the whole of the volumes now composing the Free Library, numbering about 15,000; Dr. Shepherd's reference library, 8,000 volumes; and 20,000 other volumes will be purchased. Since the commencement of the building, another wealthy Prestonian, the late Mr. R. Newshden, bequeathed to the town his fine collection of oil paintings, water-colour drawings, and curios, valued at upwards of £30,000, and these will form part of the picture gallery in connection with the Free Library and Museum. The trustees have granted £40,000 as an endowment for a school of literature, art, science, and technical education, now in existence as the Harris Institute, and have since made a further grant of £30,000 for the building and furnishing of a technical school, to be called "The Victoria Jubilee Technical School," and the Corporation of Preston are seeking powers in the present session to grant a site worth £10,000 and a further sum of £10,000 towards this object.

Abstracts of Papers, Lectures, etc.

ROYAL UNITED SERVICE INSTITUTION.

On the 27th Jan. Captain H. de H. Haig, R.E., delivered a lecture on the Pneumatic Dynamite Gun. He said small charges of dynamite and gun-cotton had been fired in projectiles, but usually such experiments had resulted in the premature explosion of the shell in the bore and the consequent destruction of the gun. The idea of propelling such shells by means of compressed air was first worked out by Mr. Mefford, of Ohio, United States, who constructed a gun for the purpose and submitted it for trial by the Government at Fort Lafayette, New York Harbour, in 1884. The task of experimenting with this weapon was entrusted to Lieutenant Zalinski, of the 5th Artillery, who, while experimenting to ascertain the best means of exploding his shells made the discovery that very much greater results were obtained when the charge was exploded from the rear than when the initial point of ignition was in front. This was explained by considering that the charge took a short interval of time to explode, and when the initial point was in front the remainder of the explosives was blown backwards by the gases first developed, and *vice versâ*. The next difficulty was a satisfactory fuse, which would explode the shell whether it struck a ship or fell into the sea. The requirements were—the impossibility of a premature explosion in the bore of the gun; the certainty of exploding the charge from the base of the shell on striking any hard substance; and the certainty of exploding the charge if the shell fell into the sea. He solved the problem by placing two electric circuits in the shell, the motive power being small chloride of silver batteries. Either of these circuits when closed and complete would cause a current to pass through a detonating fuze in the base of the shell. The current heated a short piece of platinum wire, which set off the detonating composition, and it in turn exploded the charge. These two circuits were kept open and incomplete until the right moment, thus the first one had a gap in its circuit in the front of the shell which could not be closed before the whole contents of the shell moved bodily forward, and this could only happen on its motion being suddenly arrested by some hard substance; the second circuit was complete, but the battery was dry, and there was consequently no current; sea-water penetrated through a hole in the shell, wetted the cotton-wool in the cells of the battery, and thus started the current, which fired the shell as described. The 8in. gun, mounted at Fort Lafayette, threw a shell containing 100lb. of explosive to a distance of 3,000 yards, with an elevation of 33deg. and a pressure of 1,000lb. The projectile was made of drawn brass or mild steel, with a solid head, to get the centre of gravity well forward. As the pressure in the bore was very small it was a desideratum to get the shell as light as possible, and so the walls were made very thin. It was necessary for accuracy, however, that the projectile should revolve about its longer axis, and to make it do so a tail of wood, with spiral wings or feathers at the end, was attached to it, giving it somewhat the appearance of an arrow. The first shells used had long tails like rockets, the centre of gravity being very far forward owing to the cast iron head; they flew fairly well. The primary object of the gun was to throw what was practically a torpedo, and its chief field of action was the hull under the water. As regarded accuracy of fire the pneumatic gun was very satisfactory. The cruiser now being built for the United States Government is to carry three of these guns, two of 10½ in. and one of 12½ in. The 10½ in. shell will contain 200lb. of explosive gelatine, equal to 320lb. of dry gun cotton, and the 12½ in. 400lb., or equal to 652lb. of the same explosive. The new guns will be of bronze, mounted on improved carriages, and will have novel arrangements for loading. One man will be able by the movement of a single lever to open the breech, cause a projectile to be placed in the bore, close the breech, and put another projectile in position for loading.

GLASGOW GEOLOGICAL SOCIETY.

On February 16th a meeting was held, at which Professor Sir William Thompson read a paper on "Polar Icecaps and their Influence in Changing the Sea Level." It might be found, he observed, that the most probable explanation of some changes of sea level, familiar almost to people who were not geologists, was the supposition of the shiftings of ice either on the Antarctic hemisphere or from the Antarctic to the Arctic regions. The extent of the Antarctic hemisphere, according to Dr. John Murray, of the *Challenger*, was about one-fortieth of the whole area of the earth. In the event of 1,200 ft. of ice on that hemisphere flowing into the water, it would raise the sea level all over the world to the extent of 25 ft. The latest change on the Firth of Clyde, which probably dated back not many thousand years, was only 10 ft., and consequently involved only 400 ft. of difference on the Antarctic ice. In illustration of this subject he exhibited pieces of a pine tree found embedded in floe-ice in a Siberian river, after having come across the North Pole. Of course, there might be islands about the North Pole, though there was no reason to say so, but there was certainly a great quantity of water which had a free flow under the ice. It was possible that the land sloped up to the South Pole to such an extent as to be clear of snow.

EDINBURGH UNIVERSITY CHEMICAL SOCIETY.

At the meeting held on the 15th of February, Dr. J. Gibson gave a lecture on "Spectroscopic Analysis," and Mr. King communicated a paper by Mr. T. R. Marshall, B.Sc., on "Fractionation as a means of obtaining pure beryllium compounds."

ROYAL PHYSICAL SOCIETY OF EDINBURGH.

At the meeting held on February 15th, Dr. R. H. Traquair gave some very interesting notes on carboniferous Selachii found in clay beds under ironstone. He also showed the meeting a remarkable fossil of a small fish found in the Eskdale Bed, which was in shape somewhat like an eel, but which from its construction could be in no way related to it. He proposed to call the fossil *Chondrenchelys problematicus*. Mr. Hugh Miller described the effects of the earthquake in the Riviera as he observed them three days after the shock. He showed that the earthquake travelled from west to east, from the fact that most of the chimney-pots were tilted west, and that the east end of the houses was in every case more damaged than the west. Mr. B. N. Peach read a paper on a new *Eurypterid* found in the upper

coal measures of Radstock, Somersetshire. He maintained that the *Eurypteria* must be a land animal, as it was found along with, and was connected with, the scorpion.

ANTHROPOLOGICAL INSTITUTE.

At the last meeting of this society Professor Flower, C.B., director of the Natural History Museum, read a paper upon the Akkas, the smallest people in the world, who inhabit the Monbuttu country, Central Africa. Since they were discovered by Schweinfurth in 1870, they have received considerable attention from various travellers and anthropologists, and general descriptions of them have been published, but until now no account of their osteological characters has been given, and no specimens have been submitted to careful anatomical examination. The two skeletons dealt with by Professor Flower were lately sent home by Emin Pasha. They are those of fully grown-up people, a male and female, and are both smaller than any other normal skeleton known, smaller certainly than the smallest Bushman's skeleton in any museum in this country, and smaller than any out of the 29 skeletons of the diminutive inhabitants of the Andaman islands. The height of neither of them exceeds 1,219 mètres, or four feet, while a living female Akka, of whom Emin Pasha has sent careful measurements is only 1,164 mètres, or barely 3ft. 10in. The results previously obtained from the measurements of about half a dozen living Akkas are not quite so low as these, varying from 1,216 to 1,420 mètres, and give an average for both sexes of 1,356, or 4ft. 5½in. It is to the "Negrillo" race of the great Negroid branch that the Akkas belong, and they are not by any means closely allied, either to the Bushmen or the Negritor of the Indian Ocean, except in so far as they are members of the same great branch, distinguished among the general character by their closely curled hair. It is possible that the Negrillo people gave origin to the stories of pigmies, so common in the writings of the Greek poets and historians, and whose habitations were often placed near the sources of the Nile. The name Akka, by which Schweinfurth says the tribe now call themselves, has singularly enough been read by Mariette Pacha by the side of the portrait of a dwarf in a monument of the ancient Egyptian Empire.

EDINBURGH GEOLOGICAL SOCIETY.

At the meeting on February 16th, Mr. James Melvin gave an account of the "Parallel Roads or 'Seter' of Central Norway." In general, he said, they were far more distinct and easily traced than those of Lochaber, but in several respects they were alike. From the consideration of the nature and origin of those "seters" or roads, the past history of the changes of climatic conditions might be traced. Of all natural phenomena, they supplied the most striking and convincing proof that not many thousand years ago other conditions than the present prevailed over the northern hemisphere, and also in that of the south, akin to those of Greenland at the present day.

Mr. George Craig contributed a paper on "The Culbin Sandhills," which he said were about four miles in length, from one to two miles in breadth, and lay along the southern shore of the Moray Firth. This vast mass of sand was continually moving eastwards.

Mr. H. M. Cadell of Grange, read a notice of two stumps of trees recently exposed in the oil workings at Oakbank. Each was surrounded by a cylinder of coal a quarter of an inch in thickness, he said, such as is commonly found round fossil tree stems. The main point of interest was the evidence they supplied as to the existence of an old land surface there during the Oil Shale or Upper Calciferous Sandstone period. Similar fossil stumps were known to occur in the shales just below the Burdiehouse limestone and in the Wardie shales, situated several hundreds of feet below this limestone. The occurrence of stumps *in situ* was only one of the numerous proofs that the calciferous sandstone series was a shallow water deposit.

THE INSTITUTION OF CIVIL ENGINEERS.

At the meeting held on Tuesday, the 14th of February, the President, Mr. Bruce, being in the chair, the paper read was on "The Economic Use of the Plane-table in Topographical Surveying," by Mr. Josiah Pierce, jun., M.A. The author stated that the plane-table, being one of the most ancient of surveying instruments, needed no introduction. However, he desired to direct attention to its wide and economical use on nearly all Government surveys, and to the fact that experience had proved that, within certain practical limits, plane-tabling was the most rapid, accurate, and economical method of executing topographical work. The modern plane-table, when properly constructed, was an altazimuth instrument of precision; with it the horizontal projections of existing angles were recorded graphically, free from errors of record, adjustment, and plotting.

LIVERPOOL GEOLOGICAL SOCIETY.

At the meeting held on the 14th of February, Mr. C. Potter exhibited a case of worked flints obtained from the Wirral peninsula, and especially from the surface soil immediately underlying the sandhills on the shore, together with some interesting specimens of very ancient pottery from the same locality. Mr. E. Dickson read a paper on "Preston Docks Excavations," describing in detail the nature and thickness of the old river deposits which have been cut through in the course of the works at Preston. He also described the fine series of human skulls, heads, and horns of animals, etc., and the very interesting old canoe recently found in the deposits. This latter was stated to be formed (probably by burning) out of a single log of oak, eight feet nine inches long, with no keel, and with a curious insertion of a board to form the stern end. The boat was found embedded in the gravel at a depth of fourteen feet below the surface, and is placed, together with the other objects of interest found, in the Preston Museum.

LIVERPOOL ENGINEERING SOCIETY.

Mr. J. A. Saner read a paper upon "Floodgates and Weirs on the River Weaver," at the meeting on the 22nd February. Mr. Saner described the physical features of the Weaver, its floods and currents, and explained the system of floodgates in force at the various locks.

SOCIETY OF ARTS.

At the meeting of the Foreign and Colonial Section, on February 7th, Mr. H. C. Beeton read a paper on "British

Columbia." The author gave a description of the country, paying special attention to its coalfields, mines, and forests.

On the 10th, Captain Manifold, R.A., communicated to the Indian Section an account of the work of the Afghan Frontier Commission, which contained nothing of scientific interest.

On the 15th Mr. John Harrison read a paper on "Type-writers and Type-writing," in which the author traced the development of the type-writer and pointed out its great utility.

EAST OF SCOTLAND ENGINEERING ASSOCIATION.

At the meeting of this Association, held on February 22nd, Mr. H. H. Campbell read a paper on "The Discharge of Rivers and Streams, with comparisons of different formulæ." Referring to the importance of arriving at an accurate determination of the discharge of rivers under their different conditions, and to the principles that govern the flow or discharge, the two methods of gauging, viz., by rectangular or V-shaped notches, and, where these are impracticable, by the simple expression $Q = AV$, were considered. Comparing the various formulæ framed for the rectangular notch, those by Francis and Turner were contrasted by tabulated results with others in which the uncertain element of a co-efficient is employed, and preference expressed for the former, in that they altogether avoided this uncertainty. The V-shaped notch, designed by Professor James Thomson, was next treated, and described as specially adapted for the measurement of shallow and varying flows.

ROYAL HORTICULTURAL SOCIETY.

At the February meeting of the Scientific Committee, a communication from Mr. C. B. Plowright was read, in which he said, having in my herbarium some specimens of the fungus of the Silver Fir which Mr. Munro had sent me some years ago, I submitted them to Professor Julius Kühn, with the request that he would examine them and report whether they were the true *Æcidium columnare* of Albertini and Schweinitz, which has its teleutospores of *Vaccinium Vitis-idæa* as *Calyptospora Gœppertiani*, or whether they were the recently described *Æcidium pseudo-columnare* into whose life cycle the *Calyptospora* does not enter. Professor Kühn in reply says that they belong to his *Æcidium pseudo-columnare*, a fungus which has not previously been recorded as British.

A specimen of honey from *Eucaliptus globulus* from Adelaide, South Australia, was exhibited. It is said to possess similar properties to those of the tree itself; being, for example, antiseptic in its nature. It is found to be very efficacious in cases of lung disease. The honey can only be procured every other year, as the tree flowers biennially. It has a very peculiar flavour and scent.

Mr. T. Christy sent a growing plant as well as seeds of "*Jambul*" *Eagenia Jambolano*, an important drug. Its peculiarity resides in the power of its seeds to arrest the conversion of starch into sugar; hence it is of great value in certain diseases. The seed appears to contain about 31·4 per cent. of oil and 4·32 per cent. of ash; a yellow-green resin and a crystalline principle are also present. Experiments with starch and malt extract, with and without jambul, showed that while 22·4 grains were converted into sugar where no jambul was present, only 9·8 grains were changed with 15 grains of the seed; and 6·3 grains of starch became sugar with 25 grains of jambul. It is now used very extensively in America and Germany, and has begun to be employed in England apparently with very beneficial results. The seed does not appear to contain any starch.

LIVERPOOL SCIENCE STUDENTS' ASSOCIATION.

On February 17th Mr. W. H. D. Deane, M.A., read an exhaustive paper on the subject of "Comets and Meteors" before this Association.

GREENOCK PHILOSOPHICAL SOCIETY.

On February 10th Mr. Cathcart W. Methven delivered a lecture on "The Early History and Development of the Art of Diving, and the Application of its Principles to Submarine Engineering Works." The lecture embraced the whole subject of diving from the earliest records of classical writers down to the latest developments of the various kinds of modern apparatus employed for submarine engineering works.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

AURORA BOREALIS AND MAGNETIC PERTURBATIONS.

In answer to the question of your correspondent, "A Student," I am happy to be able to inform him that the absence of clouds on the 26th of last month allowed a very careful examination of the solar surface to be made on that day, and the sun was found to be perfectly spotless. On the 25th there was only one small spot, covering one two-hundred-thousandth of the solar hemisphere, and on the 28th a new spot that had broken out, was smaller even than that seen on the 25th. The sun could not be observed on the 27th.

I venture to ask in my turn whether your correspondent is quite certain as to the date of the magnetic disturbances observed in France. My photographic record shows nothing abnormal in the magnetic force on January 26th, but it does indicate very considerable magnetic disturbance earlier in the same month. If the storm observed in France was so local, as the date given would lead us to suppose, we could scarcely expect any corresponding display of solar energy, as magnetic storms connected with solar outbursts would probably be felt throughout the whole of the surface of our earth.

S. J. Perry, F.R.S.

Stonyhurst.

FLAME CONTACT IN WATER HEATING.

In your criticism on my experiments as to the absence of flame and also the absence of high temperatures in the thin zone surrounding all vessels containing water, the most important part of my proofs seems to have been overlooked. The space appears to me to be filled with a viscid or closely adherent film of air, which is exceedingly difficult to remove and which slowly conducts heat, while at the same time it offers an impossible barrier to flame, whatever its temperature or force of impact. That a high temperature does not exist in the space, and that a resisting film *does* exist, is to my mind conclusively proved by the fact that the paper on the bottom of the vessel is instantly and completely charred through by contact with a wire or other *solid* body at a very much lower

temperature than that of a flame, which is absolutely powerless. A solid body penetrates easily through a viscid film of air and instantly burns the paper, whereas a flame, even if urged by a blast of air under heavy pressure, simply beats against an elastic film of air, which transmits the heat slowly through the paper to the vessel. My experiments tend to prove that this adherent film disappears when the metal reaches a high temperature, and from the average of a number of results under different conditions, I come to the conclusion that when the flame could be got into practical contact with the metal its efficiency, area for area, was increased about six times, other conditions being equal and the source of heat being the same. The experiments were so complete and the results so conclusive that, in the absence of unquestionable proof to the contrary, the existence of a cold zone on the surface of metal vessels containing water, must be taken as an established fact. The existence of an adherent film of air on the surface of all solid bodies does not necessitate the upsetting of any present theories; in fact, makers of barometers and thermometers have to deal with this film as a commercial difficulty and are fully aware of its existence.

Warrington. THOS. FLETCHER.

I am disposed to agree with Mr. Fletcher that a thin film of air or gas (or perhaps a mixture of both) does exist between the bottom of the metal vessel containing water and the flame with which it is being heated underneath. Our slight difference of opinion is as to the cause of this intervening film. Mr. Fletcher appears to think it is a "viscid or closely adherent film of air," which somehow or other retains its position under the bottom of the vessel and offers an impassable barrier to the flame, whatever its temperature or force of impact. Against this theory I would point out that as the film is not enclosed, it would be physically impossible for it to resist the impact of a flame driven against it with pressure.

A more simple explanation, and doubtless a more correct one, is that, owing to the low temperature of the metal vessel, due to its containing water, flame does not actually come in contact with it because the gases immediately under the vessel cannot attain a sufficiently high temperature to produce flame. If this is the case, it naturally follows that there will always be a film of unburnt or partially burnt gas and air between the flame and the vessel.

Such a result is not observable if the metal vessel is empty, and it is allowed to attain a high temperature—doubtless because there is no longer anything to hinder the complete oxidation of the gas and the production of flame in contact with the heated vessel. If, on the other hand, we accept Mr. Fletcher's explanation, how are we to explain the absence of his "adherent film" of air when the vessel is hot enough to promote the combustion of the gases in contact with it?

THE WRITER OF THE ARTICLE.

VOLAPÜK.

In a conversation with some friends the other day on the above linguistic convenience, and the general utility of an international language, mention was made of the extraordinary success which seems to mark the progress of the Jews in certain commercial lines, and an attempt was made to connect that success with the fact that most if not all of the better-class Jews, no matter in what country they are born and bred, learn Hebrew, and thus acquire a language which enables them to communicate with their co-religionists in all parts of the world. Considering the comparative fewness of the Jews as a nation—about eight millions in all is, I think, the present estimate, with about 60,000 in the United Kingdom, and less than that number in France—the number of well-known names supplied by the sect seems striking enough to warrant some consideration and search for the cause. The names of Disraeli, Gambetta, the Rothschilds, Bleichroders, Hirsch, Jessel, Montefiore, Sassoon, Bernhardt, occur to me while writing, and the list could, of course, be very largely extended with a little inquiry. In the financial world they seem to practically reign supreme, and as it is particularly in the cosmopolitan dealings connected with international finance that the value of an intermediary language would be felt—thus enabling, for instance, a Jew from Barbary to conduct a negotiation with his co-religionist in England without the assistance of a third party as an interpreter—it certainly seems that the possession of this intermediary language is at any rate one important factor to be taken into consideration in trying to account for the fact that the Jews lead the van in international financial enterprise.

I have no practical acquaintance as yet with Volapük, and so I am unable to pass any definite opinion on its merits; but I certainly agree with the spirit of the article in your issue for 24th February, and think it does not need a prophet to foresee a great stumbling-block to the diffusion of the language, if its framers have arbitrarily selected the words composing it, and have omitted to call to the aid of learners the mnemonic advantages of basing their language on roots common to the chief Aryan languages of Europe. METHYL.

METEOROLOGICAL NOTES.

The severe weather of the last three winters, combined with our similar experiences during the winters of 1878-9, 1879-80, 1880-1, lead us to seriously question the theory put forward some years ago by Mr. Glaisher, that our climate is getting milder. It was asserted that the temperature of the year had become two degrees warmer than it was 100 years ago, and that the month of January showed a rise of no less than three degrees.

This conclusion is not borne out by a comparison of the yearly temperatures at Greenwich since 1840. I have grouped the forty-seven years elapsed during 1841-87 inclusive into periods of about eight years each, and it will be noticed that the last fifteen years of the series are colder than the mean of the whole series:—

Period.	Mean Temperature.
8 years 1841-8	49·4 degs.
8 years 1849-56	49·0 ,,
8 years 1857-64	49·45 ,,
8 years 1865-72	49·7 ,,
8 years 1873-80	49·1 ,,
7 years 1881-87	49·1 ,,

Mean of the 47 years = 49·3 degs.

The result found by Mr. Glaisher is probably to be attributed to the facts that 100 years ago Greenwich was far less densely populated than now, and that the circumstances of the observations have not been continuous, and therefore the results are not strictly comparable during the long period alluded to.

Several references to the formation of hoar frost have been made in the recent numbers of SCIENTIFIC NEWS. Hoar frost is simply frozen dew or fog, and we find it chiefly deposited when there are no clouds and terrestrial radiation is very profuse. With an overcast sky there is little evidence of hoar frost.

The value of the meteorological summary for 1887 printed on page 141 of the current volume could be much enhanced if "B. A." gave his *place of observation*. It is always most important to mention the locality in such cases.

A MEMBER OF THE LIVERPOOL ASTRONOMICAL SOCIETY.

INCIDENCE OF TECHNICAL EDUCATION.

In the article headed "The Struggle for Existence," Prof. Huxley is quoted as saying, and that with justice, that "our education rate is in fact a war tax, levied for purposes of defence." Yet, with doubtful consistency, he contends that, "for technical schools, the taxation should be local." Surely every taxation for national defence should have a national basis! JUSTICE.

THE CAUCASUS.—In addition to Elbruz, the culminating point of the range, several peaks of the Caucasus are now found to exceed 16,000 feet in height. Schkara and Djanga are respectively 17,200 and 16,900 feet; Koshtantan is 17,096, and Djchtan is 16,925.

TECHNICAL EDUCATION NOTES.

Benevolent Society of St. Patrick.—Lord Macnaghten will preside at the anniversary festival to be held at Willis's Rooms on the 17th of March. Additional interest attaches to the proceedings this year, from the fact that the governors are known to have under consideration plans for introducing practically some kind of technical instruction suited to the children in their schools and the ranks of society from which these are drawn.

National Association for the Promotion of Technical Education.—A conference between the Executive of the Association and representatives of various large towns, in which branches of the organisation have recently been formed, was held on February 29th in the Conference Room of the House of Commons. Lord Hartington presided, and amongst those present were Lord Ripon, Sir Henry Roscoe, Sir J. Lubbock, Mr. A. H. Dyke Acland, Mr. Munro Ferguson, and Sir F. Mappin, and delegates from Manchester, Nottingham, Leeds, Newcastle, Luton, etc. The discussion turned mainly on what authorities should have the direction of technical education, and from what sources the funds for such instruction should be derived. Resolutions were agreed to on these subjects, and will be considered at the next meeting of the General Council. It was also decided to press the Government for grants from the Imperial Exchequer in aid of the higher university colleges.

North of London.—A meeting of the provisional subcommittees representing Hackney, Stoke Newington, and Islington, in furtherance of technical instruction was held at the Islington Vestry Hall, on Thursday evening, with a view of discussing whether the several parishes constituting the north of London shall unite in a joint scheme, or shall each support one for itself. Mr. W. T. Paton, well known from his connection with the Polytechnic, was in the chair, and introduced the subject, expressing his regret at the absence of representatives from St. Pancras, who had been invited, and, indeed, as he understood, had expressed the intention of being present. It was ultimately resolved, on the motion of the Rev. A. Brooke, rector of Hackney, "that in the opinion of this conference it is desirable that the North of London should accede to the suggestion of the Charity Commissioners in favour of a scheme for a technical institution or institutions, so that the scheme be settled as to benefit directly the poorer classes, both as regards its educational and social aspects." It was further agreed, at the instance of Mr. J. E. Viney, that the four parishes of Hackney, Stoke Newington, Islington, and St. Pancras should be invited each to appoint representatives with power to meet and formulate a joint scheme in furtherance of the previous resolution.

Mechanical Glass-Blowing.—A novel process for moulding and blowing glass bottles has been brought into successful action at the works of Messrs. Sykes, Macray, and Co., of Castleford. A comparative description of the old system (blowing by mouth) and of the new process cannot be here given without too great an introduction of technicalities. But it may be mentioned that the use of the new machines will increase the productive power of the works ten-fold. The firm estimate that in place of the 420 gross capable of being produced daily at their works they will be able to produce 4,200 gross, and this by employing only 180 hands in place of 300 as at present. Work will, however, we learn, be found for the remainder. As regards the cost of production it is said that the present labour-cost, which is 3s. 6d. per gross, will be reduced to the low figure of 3d. per gross. A collateral advantage is that glass-blowing by mouth is an unsanitary calling, being decidedly injurious to the lungs. Thus on the score of public health we may rejoice at its prospective cessation. It is hoped that the novel process will enable this country to recover its lost glass-bottle trade.

RECENT INVENTIONS.

The following list has been compiled especially for the Scientific News, *by Messrs.* W. P. Thompson *and* Boult, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

Utilisation of Coal Slack.—A method of using the waste of coal for fuel has been patented by Mr. L. A. Brode, St. Andrew's-road, Glasgow. The coal waste is ground to a powder and placed in a mixing machine. To the powder is added a sufficient quantity of a solution, which is formed by mixing boiling water, ground rice waste and silicate of soda. The whole of the powder and solution having been mixed produces a thick, clayey substance, which is then moulded into blocks, dried, and used as fuel.

Hat Ventilator.—A ventilating band for hats has been patented by Mr. W. Whittaker, Seymour Street, North Denton. A perforated metal band, covered on one side with any suitable material, and on the side worn next the head with a grease-proof material, is sewn to the inside of the leather or other lining of the hat, and secured to the hat body by projecting metal pieces, at such a distance as to leave an air space between the band and hat body, the dimensions of which space can be regulated by the fold of the projecting piece. The hat lining is perforated.

A Dynamo Electrical Machine.—Mr. S. Z. de Ferranti, West Kensington, London, has patented a dynamo electrical machine. The armature is made of a number of coils ranged around the circumference of a disc, but in place of making each coil from a flat strip of metal it is made from a strip of metal which is hollowed in cross section, so that the outer coils overlap the inner ones. In this way the overlying coils are kept from shifting sideways, and a much stronger coil is obtained which will retain the form in which it is originally coiled, and will not elongate away from the centre of the disc, when the latter is rapidly rotated.

Pianoforte.—Mr. R. Davidson, 2, West Newington Place, Edinburgh, has patented a pianoforte. This invention has for its object to increase the variety of tone in the instrument, and consists in applying to the pianoforte a series of stops actuated by one, two, or several pedals, which are pressed upon the cords of the instrument, and their position is such that when pressed upon the cords they virtually divide each cord into halves, so that the length of cord vibrating and sounding when struck is one-half of the whole length of such cord, and the tone of the sound is thereby raised an octave higher, besides being softened in quality.

Pneumatic Railway Alarm.—An alarm apparatus for railway trains has been patented by Mr. A. Mathey, Rue Henri IV., Bordeaux, France. The alarm apparatus is worked by compressed air. In each passenger's compartment of a carriage is placed a handle, which on being pulled out admits compressed air from a chamber, or from the air supply working the brake apparatus, into a cylinder containing a piston which is driven forward by the compressed air and exposes a signal outside the carriage from which the alarm is given. The piston in its movement opens an aperture through which the

air passes along connecting pipes to the guards' van and there sounds a whistle or rings a bell. The signal can only be replaced by a person outside the carriage.

IMPROVEMENTS IN ISOLATING CARBON FROM SOOT.—A method and apparatus for obtaining pure carbon from soot has been patented by Mr. R. Pringle, of Granville Park, Lewisham. This invention relates to separating the carbon in soot from the foreign matter, the carbon of course being useful in a variety of ways. The soot is thoroughly mixed with water in any suitable mixing vessel, and the water and soot in suspension descend by a pipe to the separating and settling vessel, which is nearly full of water. The pipe descends to near the bottom of the settling vessel, and is there fitted with a nozzle or rose which has an impact plate a little above it. The water with the soot in suspension strikes against the plate, and the foreign matter is separated from the soot. The former sinks while the soot rises to the surface.

CANAL LOCK.—Mr. J. Rowley, of Dukinfield, Chester, has patented a canal lock. The lock is constructed in the form of a hydraulic lift, in combination with a water-tight vessel or caisson to contain the barge. The two levels of the canal are connected together by means of a vertical shaft. This shaft is large enough to enclose the largest barge navigating the canal, and extends from the bottom of the lowest level of the canal up to such a distance above the water line at the highest level as will admit of a loaded barge being floated into it. There is an entrance into the shaft on one side at the highest level, and an exit on the other side at the lowest level. The entrance and exit are closed by water-tight sluices. In this shaft is placed a water-tight vessel which will travel up and down in suitable guides. It is provided with suitable lifting gear, and so weighted that when the lifting gear is released the vessel will descend to the bottom of the shaft. The vessel has a water-tight door at each side, so that it can receive a barge at the highest level, and when the doors are closed it can be sunk to and discharged at the lowest level.

BREAKING-IN HORSES.—An apparatus for this purpose has been patented by Mr. H. H. Lake, on behalf of Mr. L. Guinet, of France. A vertical support is provided which has at its lower end a screw-threaded piece designed to be screwed into the bow of the saddle. This support is formed of two pieces, and united at the two ends. A plate and a rearwardly projecting piece are secured near the bottom in such manner that they can slide, and they are secured in place by a thumb-screw. To this projecting piece, which is slightly curved at its free end, is secured one extremity of a curved spring, the other extremity being secured to a rod extending to the upper part of the vertical support, and formed to receive the end of short reins leading to the bit in the animal's mouth. The rod works between two rollers situated in the vertical support. The apparatus is supported upon the saddle, so as to incline slightly to the rear, and is retained in position by a fork-shaped piece of leather, the upper ends of which are provided with a ring held by hooks fixed to the vertical support. The fork-shaped piece of leather is secured at its other end to the crupper buckle. The power of the spring is regulated by raising or lowering the sliding parts at the foot of the supports.

ANNOUNCEMENTS.

PRINCETON COLLEGE.—Dr. F. L. Patton has been appointed President in succession to Dr. McCosh.

COLLEGE DE FRANCE.—M. T. Ribot has been appointed Professor of Experimental and Comparative Psychology.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The meeting of the Society will be held at Oran, commencing March 29th, when opportunities will be afforded for making excursions to interesting places in Algeria.

ROYAL SOCIETY.—The Croonian Lecture will be delivered by Prof. Kuhne, of Heidelberg, on Monday, May 28th, in the theatre of the Royal Institution, Albemarle Street. Mr. Lockyer has been appointed the Bakerian Lecturer this year.

INSTITUTE OF CHEMISTRY.—At the anniversary meeting held last evening, of the Institute of Chemistry of Great Britain and Ireland, Dr. James Bell, D.Sc., F.R.S., the Principal of the Chemical Department, Somerset House, was elected President, Professor Odling, M.B., F.R.S., retiring.

GRANTS TO UNIVERSITY COLLEGES.—A deputation, consisting of the Rev. Dr. Wace (King's College), Sir George Young (University College), Professor Ramsey, Mr. Garnett (Newcastle), and Mr. Clowes (Nottingham), recently had a private interview with Sir William Hart-Dyke at the Education Department, Whitehall, with reference to grants in aid of University Colleges. Sir John Lubbock, who introduced the deputation, asked whether the Government had made up their mind to make a grant for University Colleges in accordance with the hopes held out by the Chancellor of the Exchequer last year. Sir William Hart-Dyke, having discussed the matter in detail with the deputation, promised to give them an answer shortly.

PHOTOGRAPHIC CONFERENCE OF THE CAMERA CLUB.—The following arrangements have been made:—At 2 p.m., on Tuesday, March 13th, the President, Captain W. de W. Abney, F.R.S., will open the conference in the Theatre of the Society of Arts, 18, John Street, Adelphi. The following papers will be read and discussed:—Mr. D. G. Thomson, "The Application of Photography to Medicine and Allied Sciences;" Mr. H. Truman Wood, "Applications of Photography to Science;" Mr. J. Traill Taylor, "Single Lenses corrected for Architecture;" Mr. G. S. Waterlow, "Modern Photographic Engraving and Printing;" Mr. G. Lindsay Johnson, "A Standard System of Weights and Measures;" Mr. W. Willis, "A Recent Improvement in Platinotype;" Mr. J. F. Mostyn Clarke, "The Present Value of Art in Photography"

From 2 p.m. to 5.30 p.m., the exhibition of photographic apparatus will be on view in the Library, Society of Arts.

At 8 p.m., a special lantern slide exhibition will be held in the Theatre of the Society of Arts. There will also be an exhibition of photographs by members of the Camera Club, 21, Bedford-street, Strand.

On Wednesday, March 14th, at 10 a.m., the exhibition of apparatus in the Library of the Society of Arts. The exhibition of photographs by members of the Camera Club, 21, Bedford-street, W.C., will be opened.

The conference will be renewed at 2 p.m., when the following papers will be read and discussed:—Captain Abney, "Theoretical Aspect of Orthochromatic Photography;" Mr. Lyonel Clark, "The Metamorphoses of the Silver Image;" Mr. T. Dallmeyer, "On a Further Development and Simplification of the Standard of Comparative Exposures, proposed by Dallmeyer;" Sir D. Saloman, "On a Ratio Slide;" Mr. W. F. Donkin, "A New Form of Sensitometer; Mr. Andrew Pringle, "Centrifugal Separation in Emulsion Making;" Captain Abney, "Artificial Light in Photography."

Photographers and others interested in the subjects under discussion are cordially invited to be present. The meetings are open to ladies.

DIARY FOR NEXT WEEK.

Monday, March 12.—London Institution, at 7 p.m.—*Characteristic Qualities of the Works produced by the Great Composers;* Professor Ernest Pauer.
Bradford Naturalists' Society, at 7.30 p.m.—*Microscopical Evening.*
Birkenhead Literary and Scientific Society.—*The Minute Structure of Textile Fibres;* Mr. Norman Tate, F.I.C.

Tuesday, March 13.—Royal Institution, at 3 p.m.—*Before and after Darwin;* Professor G. J. Romanes.
Royal Colonial Institute, at 8 p.m.—*The Postal and Telegraphic Communication of the Empire;* Mr. J. Henniker Heaton, M.P.
Camera Club, at 2 p.m.—*Photographic Conference*, at the Society of Arts.
Photographic Society, at 8 p.m.

Wednesday, Mar. 14.—Society of Arts, at 8 p.m.—*Technical Instruction in Agriculture;* Professor John Wrightson.
Civil and Mechanical Engineers' Society, at 7 p.m.—*On the Construction and Use of the Hopper Dredger;* Mr. A. C. Schonberg.
Camera Club, at 2 p.m.—*Photographic Conference*, at the Society of Arts.
Cardiff Amateur Photographic Society, at 8 p.m.—*Microscopic Photography;* Mr. J. Storrie.
Royal Dublin Society, at 4 p.m., *John Ruskin as a Critic and Philosopher;* Dr. C. Waldstein.
Dundee Naturalists' Society, at 8 p.m.—*Man's Unintentional Agency in the Migration of Plants;* Professor J. W. H. Trail.
Royal Microscopical Society, at 8 p.m.—*On the Type of a New Order of Fungi;* Mr. G. Massee.

Thursday, March 15.—Royal Institution, at 3 p.m.—*Microscopical Work, or the Least and Simplest Forms of Life;* Rev. W. H. Dallinger.
Camera Club, at 8 p.m.—*Description of and Discussion on Apparatus exhibited at Club Room.*
London Institution, at 6 p.m.—*A Generation's Changes in the Manufacture of Iron and Steel;* Mr. Edward Riley.

Friday, March 16.—Society of Arts, Indian Section, at 8 p.m.—*The Origin, Progress, and Influence of Universities in India;* Mr. F. J. Mouat.
Royal Institution, at 9 p.m.—*Coral Reefs and Islands;* Mr. John Murray.
Camera Club, at 8 p.m.—*Development;* Mr. Lyonel Clark.
Royal Dublin Society, at 4 p.m.—*John Ruskin as a Critic and Philosopher;* Dr. C. Waldstein.
Royal United Service Institution, at 3 p.m. *The History of the Native Army of Bombay from* 1837 *to* 1887; Major-General W. E. MacLeod.

Saturday, March 17.—Royal Institution, at 3 p.m.—*The Modern Drama;* Mr. W. Archer.
Society of Arts, at 3 p.m.—*Protection of Buildings from Lightning*; Professor Oliver J. Lodge.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Agents Wanted.—Morgan's Celebrated Improved Boiler Fluid Composition. Fifteen years' success.—W. H. MORGAN, Chemical Engineer, Gloucester.

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Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps. Wire from 1s. 4d. per lb.; castings, lamps, etc.

Dynamo, 30-candles, 29s.; 10-candles, 18s. Photo. 5 stamps. —D. WALTON, Hebden Bridge, Yorkshire.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

The Story of Creation. By E. Clodd. London: Longmans, Green, and Co. Price 6s.

Treatise on Photography. By Captain W. de W. Abney. Fifth Edition. London: Longmans, Green, and Co. Price 3s. 6d.

Short Studies from Nature. London: Cassell and Co.

Playground of Science. By Johnston Stephens. London: Truslove and Shirley. 1s.

Lectures on Electricity. By George Forbes. London: Longmans, Green, and Co. Price 5s.

An Easy Guide to the Constellations; with a Miniature Atlas of the Stars, and Key Maps. By the Rev. James Gall. London and Edinburgh: Gall and Inglis.

Management of Accumulators and Private Electric Light Installations. A Practical Handbook. By Sir David Salomans, Bart. Third Edition. London: Whittaker and Co.

The Earth's Story. By Dr. Brown. London: Cassell and Co.

Weather. By Ralph Abercromby. International Scientific Series. London: Keegan, Paul, and Co.

First Year of Scientific Knowledge. By Madame Paul Bert. London: Relfe and Sons.

Elementary Physiography. By John Thornton, M.A. London: Longmans, Green, and Co. Price 2s. 6d.

NOTICES.

The Title Page and Index to Vol. I., *First Series*, now ready, price 6d.

Binding Cases for Vol. I., *First Series*, price 2s. each.

Binding Cases and Binding, Vol. I., *First Series*, including Title Page and Index, price 3s.

Vol. I., *First Series*, bound in cloth, with Title Page and Index, 7s. 6d.—by post 8s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Prices 6d. each, or by post 7d. for the *First Series*, and 3d. each, or by post 3½d., for the *New Series*.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 11. (*New Series.*) MARCH 16th, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

SCIENTIFIC STUDY.—The students of the London Society for the Extension of University Teaching were fortunate in securing Sir James Paget to deliver the customary annual address. His text was, "Scientific Study," and in pointing out many of its advantages, he made some very useful and telling remarks. He said that some persons objected to the Society's doings on the ground that its teaching did not go far enough, and because "A little knowledge is a dangerous thing." This objection he fairly disposed of by reminding his hearers that the danger depended not so much on the quantity as on the quality of the knowledge. In some cases a little knowledge might doubtless be very rashly and unwisely used, but much more easily might total ignorance. He also referred to the common belief that scientific pursuits are not compatible with the ordinary business pursuits of life—that a man could not be at the same time a man of business and a man of science. He knew of no greater fallacy, and instanced some names equally well known in commercial as in scientific circles. There had also been many striking examples where great facts of science had been within the reach of men of science, who, as they did not see any practical utility in them, ceased almost to observe them.

Sir James Paget considers that scientific education has four great advantages. There was first the teaching of the powers of observing; then the teaching of accuracy; the teaching of the difficulty of attaining to a real knowledge of the truth; and lastly, the teaching of the methods by which one could pass from that which was proved, to the thinking of what was probable. To many it seemed to be a very easy thing to do what they called observe, but observation was really a very great difficulty. This was shown by the fact that every discovery had been made by the clear observation of facts which had been manifestly within the range of sight of many, but had been overlooked by all but the discoverer. On the second point, he remarked that accuracy would readily be admitted to be a useful thing in all the paths of life; science would teach it well. People owned the necessity of accuracy, but it was curious to notice what very different standards of accuracy they set, and many persons who would not for their lives tell a lie, nevertheless always seemed as if for their lives they could not tell the exact truth. On the third point Sir James Paget remarked that here again the popular impression was that it was not very difficult to learn what was true. He, on the contrary, showed that a very rare value of scientific education was that it required and proved again and again the utility of most careful investigation, of repeated observation, of repeated test, and of repeated examination. In dealing with the last point, he instanced the work of several well-known men of science, and specially referred to the unceasing labour which Darwin spent in collecting facts, in comparing them, in inquiring upon every side before he arrived at the point of enunciating his general law of the survival of the fittest.

TECHNICAL EDUCATION IN EXCESS.—It appears that in Germany the supply of trained intelligence now exceeds the demand, and that in consequence its market value is falling. Out of every three educated engineers, electricians, technical chemists, etc., not more than two are said to be able to obtain employment. Hence we find such men offering

themselves to manufacturing establishments as "volunteers," *i.e.*, without pay, and we recently saw in a German technical paper, the offer of a bonus of £5 to anyone who would procure the advertiser—a chemist—any suitable appointment. Among German statesmen the conviction is spreading that there is danger of higher education being overdone, and that the inability to find employment will lead to a superfluity of discontented citizens of the middle-class. Hence we in Britain, whilst granting full scope for the development of special and exceptional talent in any rank of life, should beware of seeking to force a mere technical training upon the entire population.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams., F.R.A.S., F.C.S.

In No. 6 (*New Series*) of The Scientific News is an interesting article on the Norwegian Fisheries, containing a narrative of facts that may surprise many of our readers, but is correct nevertheless—rather under than over stated. As an example of the abundance of cod fish, I may mention one fact.

On the occasion of my last visit to Arctic Norway, the packet made a halt opposite the North Cape, in order that we might contemplate and sketch that noble and notable headland, a dark, frowning perpendicular cliff overhanging in some parts, and rising sheer from the sea to a height of 1,000 feet with no beach or shore below, but plunging perpendicularly into deep water at its foot.

During the halt of about half an hour, three fishing lines were obtained and used. The lines were provided with a leaden plummet and a double hook *without bait*. I was one of the anglers, but soon resigned my line to another, as the effort of hauling up the fish from the deep water and over the ship's side made my arms ache. When the half-hour had elapsed, the fore-deck was covered with fish weighing from 10 to 15 lbs. each.

There is, however, a small error on page 133, where we are told that, "so numerous are the fishes, and so eager to be caught, that they will bite at a naked hook." The Norwegian method of fishing demands no biting. The double hook is appended to a fish-shaped piece of white metal. The angler drops the line until he feels the bottom, and then suddenly snatches it back with a full length sweep of the arm. After a few repetitions of this, a sudden resistance is felt, and the line is hauled up with a captured fish attached; but usually there has been no swallowing of the hook. It is not vulgar voracity, but the pursuit of knowledge, to which the victim has become a martyr. He sees a strange glittering creature and proceeds to investigate; while doing so the jerk of the line buries the barb of the hook somewhere about the head, commonly in the gill plates. One of my captures was startling, demanding all my strength to haul him to the surface. It was a hallibut hooked near the tail.

The catch of 1878 was estimated at sixty-two millions of full-sized cod; this was a good year. About 150,000 people are entirely supported by the Norwegian coast fisheries, besides those engaged around Iceland. The salted fish are partly exported to the Mediterranean for consumption by Catholics on feast days, and partly consumed at home.

While there, I naturally studied the question of why should there be so great an abundance of fish in this particular region, and succeeded in finding an answer which I think is satisfactory.

All the fisheries are on what are called "banks." These banks, as the plummet proves, are deposits of dark stiff clay, and they all—so far as I can learn—occur just where great glaciers have, during the glacial epoch, poured down to the sea, and the banks are submarine moraines or deposits of *till* (see "The Great Ice Age and the Origin of the Till," in "Science in Short Chapters.") I have examined such deposits of dark slate-coloured stiff clay at Bodö, Tromsö, and other places, where they are bared or very shallow at low tide, and find them richly strewed with molluscs such as are commonly found in the stomachs of these cod-fish; the molluscs themselves feeding on the abundant marine vegetation of this submarine soil.

The mode of fishing above described is also adopted by the French fishermen whose boats leave Boulogne and Dunkerque early in the year, for Iceland, and return in the autumn. I detected this when going over one of them at Boulogne, by observing the grooves worn on the bulwark by the friction of the lines. In some places there were little pulleys. The men were very reticent, evidently regarding their method of fishing as a sort of trade secret.

"A peck of March dust is worth a king's ransom." This valuation by the old saw is interesting when we remember that such proverbs are usually expressions of practical experience. Why should dry, windy weather be so valuable just now? Is there really any rational foundation for the assertion.

I think there is. In the ordinary course of the seasons the soil is fully saturated by the winter rains at the season in question, and the decay of fallen leaves is nearly completed. The grass and all other desirable vegetation is starting into growth. If we have much wet weather in March, it is evident that the rain will wash away the soluble salts that are on or near the surface of the soil, whether these are due to the natural decay of the leaves, etc., or to the manuring of the agriculturist. This will especially happen to the ordinary spring top-dressing of the farmer. If much rain follows, he loses largely just that which his infant crops require, and his harvest will suffer accordingly.

"Up-rubbed water" (*Aufreibwasser*) is a curious expression, but really a good one. It describes what occurs on some tropical coasts. The deep sea has nearly the same temperature all the world over, while the surface of the ocean takes its temperature from the air, and thus in tropical regions the difference between the temperature of the surface water and that below is considerable. This is rendered curiously evident when the wind blows steadily for a while off the tropical shore and then changes for a steady wind off the sea. Thus at Cape Guardafui the North-west monsoon blows off shore, and then the water near the land is cold. When the north-east monsoon is fairly established, the water becomes warm. This is due, in the first case, to the up-rubbing of the warm surface water and its oversliding outwards, leaving the cold water to flow shorewards and take its place. With the opposite wind the warm surface water is swept shorewards and constitutes the whole quantity of the shallow water of the coast.

Even in our own latitudes the action is observable.

Thus on Loch Ness, the water at the south-west end of this long, narrow, and deep trough is coldest when a south-west wind is blowing, and when the wind is blowing from the north-east, the south-west end becomes the warmer. At any of our seaside bathing places we may note a similar difference in the summer bathing season without the aid of a thermometer, by simply comparing our sensation on bathing before and after a change of wind from sea-ward to shoreward, or *vice-versa*.

STORMS.—III.

(Continued from page 226.)

FIG. 4 shows the dotted lines only. To find the direction of the wind at any point, the dotted line must be followed to the margin and read there. The circles are isobars or lines of equal barometric pressure; the barometer falls 0·20 inch as you go from one of these circles to the next inner one. This illustrates how the barometer falls as you approach the centre, at first slowly,

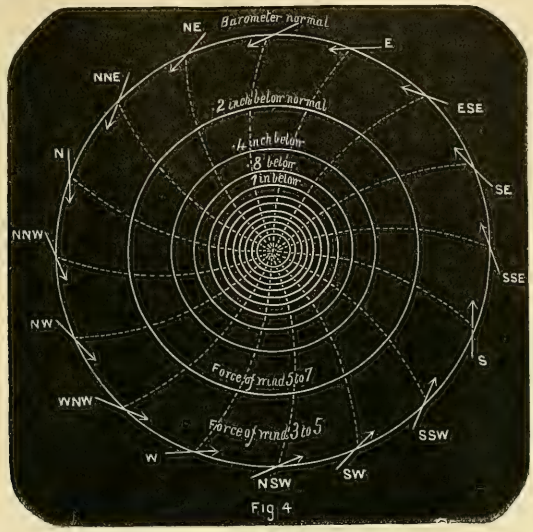


Fig 4

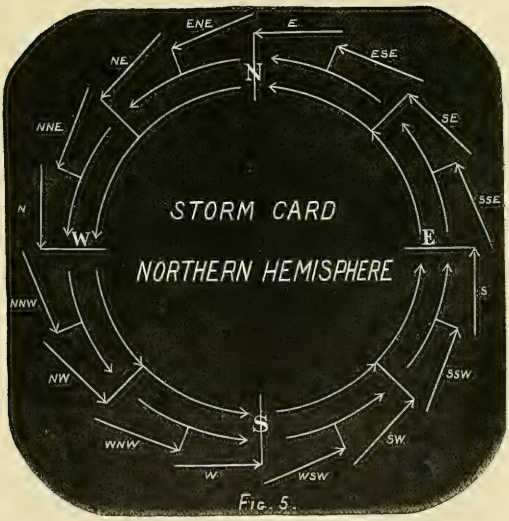


FIG. 5.

as the broader ring is traversed, and then more and more rapidly. Near the centre, where the isobars are very close together, it has been known to fall an inch in 50 miles. Of course, as you recede from the centre the barometer rises 0·20 inch as you pass from one isobar to the next outer one. So long as the barometer continues to fall, the centre is getting nearer; when it steadies and begins to rise, this marks the nearest point, and here the shifts of wind will be the most sudden and violent and the sea highest and most confused. The use of this diagram is to enable the ship's position to be found with reference to the centre of the hurricane, by means of the direction of the wind and the fall of the barometer. If the vessel is making any great way, the direction of the wind may appear different from its true bearing; this must be carefully considered, and it is best to heave to when observing. Suppose the wind is ESE, and the barometer 40 degs. below normal. Find at the margin of the diagram the wind arrow marked ESE, and follow the line in toward the centre as far as the isobar marked four-inch; this will give the position of the ship, and will give some idea of the distance of the centre of the storm. The centre should be marked on the sailing chart, and the operation should be frequently repeated, marking the storm-centre on the sailing chart; every change of relative position can then be watched, and the course can be made to run out of the storm, or if that is impossible, to take such action as may seem best, having regard to the speed of the ship, the rate at which the storm is apparently travelling, the lay of the land, and the passage that is being made. The force of the wind is given in the figures of the Beaufort scale. Fig. 5 is the storm card, with the sailing instructions as recommended by the U. S. Hydrographic Office.

LUMINOSITY IN ANIMALS.

ONE of the greatest of the many mysteries which zoologists have in vain attempted to solve is that strange capability of emitting phosphorescent light which is common to many of the lower forms of life. We find it in various insects, of which the lantern-fly, the fire-fly, and our own British glow-worm are very familiar examples. We see it in certain of the myriapods, represented in this country by the well-known luminous centipede. Above all, we find it in numbers of the jelly-fish and their allies, from the large disc-bearing species, which occasionally appear in such vast shoals, to the infinitesimal atoms, which, although individually so small that the unassisted eye can scarcely perceive them, yet throng the water so densely that at night it appears like one broad sheet of living fire. The boat passing by leaves a wake of light behind it, each splash of the oars throws up the spray like a shower of blazing jewels; and when the tide goes down and leaves the rocks and the beach exposed, one sees the seaweed closely studded with glittering points of brilliance, each like some tiny glow-worm shining with pale radiance in the darkness.

What is this light, and why is it given? No man can tell. Theory after theory has been put forward; theory after theory has been shown to be utterly false. The luminosity is an evident fact, but no chemist can account for its presence. Concerning its nature, its origin, and its functions, we are still utterly and completely at fault.

Take the case of the glow-worm. Here we have a beetle with luminosity strongly developed, due, as we easily find, to a certain liquid secreted within the body, and in some mysterious manner under the control of its owner, who can turn it on and shut it off at will. Nothing in nature is without its use; yet of what service can this light be to the glow-worm? Is it a sexual attraction, designed to guide the winged and active male to his grub-like and crawling mate? But the male possesses it also, although not in equal degree, and to him, upon such a supposition, it can be of no avail at all. And, moreover, if such be the case, why do not other and similarly constituted insects possess it? There are numbers of beetles, moths, and bugs in which the one sex is winged and the other apterous; yet we do not find that any special attraction is necessary to guide the one to the other. The female vapourer moth, a heavy, clumsy, helpless being, who cannot even walk, much less fly, is visited by suitors in scores, who detect her presence from an almost incredible distance, and wing their way with unerring certainty to the spot where she is resting. They require no guide, other than that strange instinct which all creatures alike appear to possess. Why should the glow-worm need more?

The fact that both the larva and pupa are luminous, which many writers have urged as an additional argument against the theory of sexual attraction, has no bearing whatever upon the subject. In them the phosphorescent capability is merely developing, just as are the future organs of the imago, and luminosity in some degree is inevitable from the very nature of the property in question. In the larva the anatomist can trace the rudiments at least of every organ belonging to the future perfect insect, and it were strange indeed if the luminous liquid and the glands which secrete it were suddenly to come into being with the mere casting off of the pupal skin. They, like every other part of the bodily frame, must pass through their incipient stages, and the faint light which we see in the glow-worm larva, and the somewhat stronger radiance emitted by the pupa, are the natural and inevitable concomitants of the developing faculty which attains to its perfection only in the mature beetle itself.

Is this light granted as a protection from natural enemies?

Scarcely, for its very nature causes it to act as a source of attraction rather than as one of repulsion; and certainly the glow-worm is not rejected by insectivorous animals. The present writer, for instance, once stocked a small fernery with forty or fifty glow-worms, only to find that they all perished in a couple of nights at the hands, or rather the tongues, of the toad to which the fernery in question served as a harbour of refuge. Since a toad, as we know, will repeatedly swallow fragments of glowing charcoal, it is scarcely to be expected that it should be deterred by the pale cold light of the glow-worm.

Why is this light under the control of its possessor? Some say, to protect it from night-flying insectivorous birds, at whose approach it can darken its gleaming lantern, and so remain in safety until the danger has passed away. But, I would ask, how is the beetle to be aware of their presence? Lying deep among the roots of the herbage, how can it tell that a bird, and a bird which is likely to devour it, is in its immediate neighbourhood? How is it to know that a toad or a frog is dangerously near? Even the vibration of a human foot-fall does not alarm it, much less would the almost

inaudible tread of one of its natural foes. The first intimation to a glow-worm of its peril would be its passage down the gullet of its enemy; no withdrawal of its light could possibly avail it then. And therefore, the fact that the exhibition of the light is not involuntary adds only to the mystery which surrounds it.

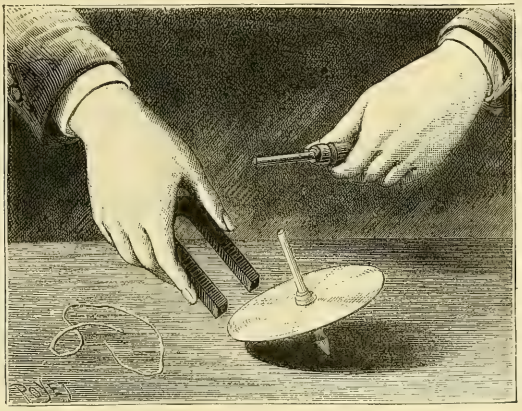
The luminosity does not entirely cease upon the death of the insect. The writer, upon one occasion noticing the familiar greenish light upon the floor of a room in which several glow-worms had been confined, found on examination that it was due, not to one of the living insects, but to the dead body of one which had evidently been accidentally trodden upon and crushed, and which had remained there sufficiently long for its corpse to have withered and shrivelled. Yet the light was still fairly powerful, although the liquid from which it proceeded was dry.

We have a second glow-worm in Great Britain, known only to entomologists, and restricted to one or two localities upon the south coast; but this, as the female has not yet been discovered, is not available for purposes of comparison. In the fire-flies and lantern-flies of the tropics, however, we find the luminosity greatly intensified, just as is the poison of the venomous snakes, and the scent of the many creatures which depend upon their offensive odour as a means of protection. Capture a fire-fly, and by passing it backwards and forwards along the lines one can see to read a book or a newspaper upon the darkest night. Yet still we are in the same condition of absolute ignorance concerning the nature of the light, its origin, and its uses. It does not appear to be in any way due to the operation of heat—a difficulty for those who insist that light and heat are almost interchangeable terms. It is certainly more intense if its producer be plunged into oxygen; but that is probably due to the increased vitality which naturally ensues from the experiment. Not the most susceptible of instruments will detect any alteration in the bodily temperature when the light is turned on or turned off. Not the most delicate of chemical tests can show us that this light is in any sense the product of combustion. The bodily functions go on just as in any other insect, and there is not even any direct communication between the secretory glands and the organs of digestion.

Neither can we say what causes the light in the centipede, the jelly-fish, or the animalcule. Again, we know nothing of the source whence it proceeds, or the function which it may fulfil. The whole subject is one of intense interest, but of equally intense difficulty. It is not a mere question of anatomical detail, but one which very probably involves some force unknown as yet to the zoologist, unknown, very possibly, to man, but of far more importance than any of us suppose or imagine. And to him who devotes his time and his energies to the work of investigating the source and the nature of this most mysterious light, the results of his labours, although they may not be conclusive, cannot but prove instructive in the highest degree.

THE INDUCTION TOP.

THE induced currents developed in metallic masses in motion, in magnetic fields, can be very strikingly displayed by the well-known experiment of Foncault's disc.



But this instrument is both complicated and expensive; hence *La Nature* thinks it useful to call attention to the much simpler apparatus represented in the accompanying figure. This instrument demonstrates in a very simple manner the existence of these induction currents, paradoxical at first sight, but susceptible of an easy explanation.

The apparatus as constructed by M. Marnet consists of a disc of sheet-iron mounted on an axle, and set in rapid rotation by means of a string like the common humming-top. When at rest, the iron disc is attracted by a horse-shoe magnet presented at any point of its surface, but when the disc is spinning rapidly, if we present either pole of the magnet, or both together at its surface, there instantly ensues *repulsion*, and the top takes an inclined position, which it retains as long as its velocity is sufficient. When the speed falls below a certain rate, depending on the thickness of the disc, on the magnet, its distance, position, etc., the repulsion ceases; the disc is then attracted, it clings to the magnet, and the magnetic properties of soft iron are resumed.

The explanation of the phenomenon is very simple. On approaching the magnet to the revolving disc, this

disc by its rapid rotation in the magnetic field produced by the magnet, becomes the seat of induced currents, which are the more intense the greater the speed of rotation. There is then a mechanical action between the disc, which is the seat of the induced currents, and the magnet which produces the magnetic field. The equilibrium of the disc can exist only if the magnetic attraction is precisely equal to the repulsion produced by the magnet upon the induced currents in the disc. As this repulsion preponderates as long as the disc has a sufficient speed, nothing is more natural than this fact—paradoxical as it is in appearance—*of a disc of soft iron repelled by a magnet.* When the velocity becomes insufficient, the attraction preponderates, and the disc is again attracted.

If the magnet be presented, not to one of the surfaces of the disc, but at the edge in the plane of the disc, no repulsion ensues, and we have then attraction just as if it were at rest. This experiment confirms the explanation just given, for in this case no induction currents can be produced, since the disc moves in the plane of the lines of force generated by the magnet.

This induction top is a simple and useful apparatus for demonstration, and ought to find a place among the appliances for elementary instruction.

ZOOGEOGRAPHY.

ZOOGEOGRAPHY is a branch of science of recent times, being one of those numerous and important stems which under the fostering influences of modern research have budded forth from the bare original parent trunk, Natural History.

Zoogeography is the name given to that science which deals with the geographical distribution of animals. It aims not only at enumerating and classifying the animals of the world, and observing their various ranges and habitats, but after duly noting the facts so observed there arise more difficult questions to which it seeks to find an answer. Why are certain animals found in one part of the world and not in another apparently equally well suited for this existence? Why is the range of one species, genus, family, or order extremely limited, while another may extend over large tracts? Why does the same genus appear in two widely separate localities while unknown in the intervening space? These are some of the problems which it is the work of the zoogeographer to find a solution.

For convenience in working the land surface of the globe has been divided into zoological regions corresponding to different more or less well-defined typical groups of animal inhabitants. The division established by Mr. Sclater, in 1837, is the one most generally received, and others differ from it only in comparatively small details. Sclater adapts six regions known as the Palaearctic, Nearctic, Neotropical, Ethiopian, Oriental, and Australian. Each of these regions has its prominent features, but none more so than the Australian, which as far as the mammalia are concerned, is tenanted almost exclusively by the Order Marsupiala. Not only is this so, but, with a single exception—the American Opossum—the Marsupialia are found nowhere else. To explain these and similar phenomena we must call geology and evolution to our aid.

In the case of the Australian fauna, a study of fossil remains teaches us that the first appearance of mammals practically occurred with the commencement of the tertiary epoch. The earliest beds of this epoch are those of the Eocene formation, and we find that the only order of mammals then existing was that of the Marsupialia, which were not then confined to Australia but spread over the world. The higher orders did not appear till late, though where they have arisen through the process of development the marsupials from which they sprung have disappeared. Thus Australia at the present day presents a vast remnant of the old universal Eocene fauna, while the rest of the world has completely distanced it in the race of development. This stagnation on the part of Australia alone is explained by the comparative smalless of its area, and the very great antiquity of the sea channel, which from the days of the Eocene fauna has cut it off from the rest of the world.

The solitary existence of the opussum in America, and similar cases where species or families are widely separated, also find their explanation from the facts of evolution. Submerged continents have by some been supposed to account for such phenomena, but evidence is opposed to such an explanation. Much light is thrown upon zoogeography by the study of Island Fauna. Two kinds of islands are recognised in physical geography—the Continental and the Oceanic.

Continental islands are those which have been formerly connected with adjacent continents, and on these, as might be expected, the fauna corresponds with that of the mainland from which they have been severed; and where the separation is one of long standing the animals present proof of modification from the original type. Examples of recent islands are Great Britain and Japan. Of ancient islands, Madagascar and New Zealand are the best type.

Oceanic islands are those which have come into existence as islands, and which from their origin have remained unconnected with any land. Such are volcanic islands, and coral islands; as, for example, the Azores, Tahiti, Galapagao, etc. To explain in a natural manner how these islands have become clothed and populated with plants and animals would at first sight appear difficult, but the observations of Darwin and others prove in what a wonderful variety of ways seeds, eggs, plants, and animals may occasionally be transported across immense tracts of ocean.

Among the most important of these may be mentioned storm-winds and ocean currents.

Many questions connected with zoogeography still remain to be solved, but of the great importance of the subject there can be no doubt, and it is probable that the full value of its teaching can only be known as years roll on. Of this we have the high evidence of Darwin himself, who talks of "that grand subject, that almost keystone of the laws of creation—geographical distribution."

THE BRITISH AND FRENCH NATIONAL LIBRARIES.—The statistics of the Bibliothèque Nationale of Paris show that 71,932 readers used that institution during the course of a year, and borrowed 213,744 works, or an average of three books to each reader. In the British Museum during 1884 there were 154,729 visitors to the reading-room, who borrowed 1,100,450 works; in 1886 the numbers were 176,893 and 1,247,888 respectively, giving in each case an average of between seven and eight books per reader. Thus, while the readers in the British institution are more than twice as numerous as in the French, each of the former borrows from two to three times as many books as the French reader.

General Notes.

Words Addressed to Animals.—Professor H. Carrington Bolton is making a collection of the words used in all countries—always excepting the oaths—in calling, driving, and guiding domestic animals.

The Blood in the Brain during Sleep.—According to Spehl (L'Encéphale), anæmia prevails during sleep in most portions of the brain, whilst certain parts which are active in sleep may be in a state of relative congestion.

Prehistoric Human Remains.—In a splendid stalactitic cavern recently discovered (Humboldt) in the Bilstein in Sauerland, Germany, there have been found the skull and the thigh bones of a man, among a quantity of other animal remains.

The New Guinea Mountains.—The Owen-Stanley range in British New Guinea has been in part explored by Messrs. Hartman and Hunter. It does not appear that they have reached the highest summits, but the flora is described as magnificent in the extreme.

Origin of Odours.—Professor Leclerc, writing in *Cosmos*, maintains that odours are due not to the emanations, *as such*, of so-called odoriferous bodies, but to a vibratory movement among such emanations, due to processes of oxidation. Scent, on this theory, is analogous to sound and light.

On Prolonged Anæsthesia Produced and Continued by a Mixture of Nitrous Oxide and Oxygen.—M. Claude Martin, in a memoir presented to the French Academy of Sciences, proves that in this state, even if very protracted, no injurious product accumulates in organism, so as to occasion serious results.

Vowels of Acute Sound.—M. E. Doumer (*Comptes Rendus*) concludes that the sounds *i* and *u* (French) are pure vowels, a harmonic relation existing between the reinforced sound and the laryngeal sound. The characteristic note of the vowel *i* is close upon do_6 or is situate between do_6 and re_6. The characteristic note of the vowel *u* is deeper by two notes, and corresponds to la_5 ranging from sol_5 to si_5.

Left-handedness.—*La Normandie Médicale* has lately summarised the observations of various authors on this subject. The writer does not fully accept the generalization of M. Galippe that we are right-handed by atavism and left-handed by a morbid heredity. He suggests that a solution of the problem should be sought by ascertaining if any similar phenomenon occurs in the lower animals. M. Debierre thinks that our primordial type was that of ambidexterity.

Insanity among Negroes.—According to a Government report quoted in the *Medical Press*, the proportion of insanity among the negroes in the West Indies has steadily increased since their emancipation. In 1860 the insane were as 1 in 5,799 of the negro and negroid population. In 1870 it was 1 in 2,695, and in 1880 1 in 1,096. If this "progress" continues, by 1890 the negroes will exhibit the same liability to mental disease as the Aryan part of the population, 1 in 500.

The University of Harvard.—This institution, which dates back as far as 1637, is liberally endowed. In early times it was a strictly religious organisation, and most of the graduates became clergymen. It has latterly been secularised, so that no denominational religion is insisted on, and not one-twentieth of the graduates enter the churches. There are at present 1,400 students in the various departments of Harvard, and about fifty-five professors.

The Chinese Wall.—According to the recent measurements of an American engineer, given in the *Centralblatt für Bauverwaltung*, this rampart has a solid content of 6,350,000,000 cubic feet, or about seventy times more than the largest of the Egyptian pyramids. Its cost must have been about as great as that of the entire railway system of the United States. Yet the work was completed within twenty years, and without borrowing money.

On the Evolutionary Cycle of the Morphological Variations of Bacterium Laminariæ.—In the study of this species M. A Billet (*Comptes Rendus*) finds additional proof of the inconstancy and variability of the forms of the bacterian element. He shows that certain species of bacteria may, in one or the same medium, pass through a certain number of those evolutive phases which make of the bacteriaceæ one of the vegetable groups whose morphology is most complex.

Weather Prediction.—*Uhland's Wochenschrift* recommends for observing the degree of atmospheric moisture an improved hygrometer. A careful determination of this element of the weather is important, not merely for the meteorologist, the sanitarian, and the farmer. In the drying-rooms employed in the starch manufacture, in calico printing, and in various other industries a proper treatment of the materials in question is not practicable without an accurate knowledge of the degree of atmospheric moisture.

The Affinities of the Eskimo Tribes.—Professor Flower considers that there exists an affinity between the Eskimos and the Japanese, the Aleutians forming, as it were, the connecting link. He remarks that "every special characteristic which distinguishes a Japanese from the average of mankind is seen in the Eskimo in an exaggerated degree. These special characteristics increase from west to east, and are seen in their greatest perfection in the inhabitants of Greenland—at least, where no intermingling with the Danes has taken place.

Low Winter Temperature in Bottoms of Valleys.—J. Hann (*Meteorol. Zeitschrift*) has collected observations showing that the winter temperature is lower in the bottoms of valleys, or in depressions, than it is on adjacent hill-sides. The Central Meteorological Institution, in Neukirchen, in Pinzgau, lies on the left bank of the Salzach, about 162 feet above the river, and at a distance from it of 622 yards. At the Institution the thermometer on January 8th, 1887, 11 a.m., marked $-13{\cdot}3°$ centigrade, whilst in the middle of the valley, only 500 paces off, it stood at $-20{\cdot}4°$ Cent.

Wood-Hangings for Walls.—For more than thirty years there has been used in America for hanging, a kind of paper one side of which is wood. Different

kinds of wood are sawn very fine, as if for veneers, and paper is pasted over one side. The whole is passed under rollers, and in this manner a sheet is produced scarcely thicker than ordinary paper-hangings, and very easy to apply. The paper side is turned towards the wall. These compound hangings may be varnished and polished like wood.

THE PITH IN PINE-TREES.—M. Emile Mer has submitted to the Academy of Sciences of France an elaborate memoir on the conditions of growth of coniferous trees. The pith is not always in the centre, because the rings of annual growth have not a constant thickness. The causes of this irregularity are slope of the ground, the exposure, the proximity of other trees, and the effects of injuries. Trees whose layers of growth are very irregular yield generally wood which is not homogeneous, since its elements have neither the same distribution nor the same structure. Hence the technical properties of the timber are modified, and its industrial value is reduced.

COLOUR-DISPERSION OF THE EYE.—A simple method for demonstrating this phenomenon has been indicated by O. Tumlizz (*Pflüger's Archiv* and *Humboldt*). For this purpose an image produced only by the marginal parts of the lens is most suitable. To cut out the central rays, Tumlizz looks at a vertical ring formed of this platinum wire, glowing at a white heat in a non-luminous gas-flame, and moves an opaque screen with a round aperture about half an inch in width, so far from the eye towards the luminous ring as can be done without covering the latter. The ring appears then outwards red, and within violet-blue. The ring should be 4-5ths of an inch in diameter, and the eye is directed to its centre.

SYMMETRICAL DISTRIBUTION OF THE CENTRES OF THE FOUR MAIN CONTINENTS.—M. Alexis de Tillo (*Comptes Rendus*) calculates that the orographic centre of Asia and Europe is situate in latitude 43° N. and longitude 85° E.; that of Africa in 4° N. and 27° E.; that of North America in 45° N. and 102° W., and that of South America in 14° S. and 56° W. These four centres form a nearly regular quadrilateral. The longest side (92°) lies between the centres of Asia and Vorth America; the centre of Africa is 82° from that of South America. The distance between the centres of the double continents is approximately the same. The geometrical centre of all these four centres is in the region of the Azores. Hence the author considers the meridian of Ferro the natural meridian of the globe.

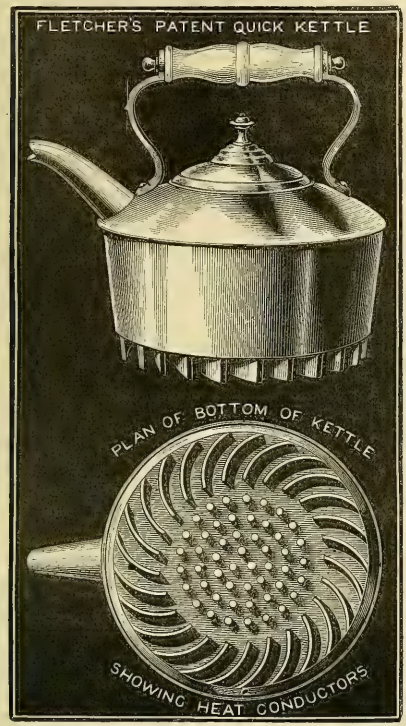
UNDERGROUND WIRES IN NEW YORK.—We are pleased to learn that good progress is being made in the conversion of the present overhead to an underground system of electrical wires in New York. It is indeed time that the huge poles, covered with advertisements, and laden with scores of wires, should no longer be allowed to disfigure the handsome streets and buildings of this important city. It appears that under authority from the Board of Electrical Control, a company is constructing subways to be used by electrical companies on terms impartially determined. The profits of the subway company are not to exceed ten per cent. on the actual outlay, any surplus going to the city. Under the new law, as soon as a sufficient length of subway has been constructed in any district, the Board are required to give the electrical companies notice to remove their wires, and if they neglect to do so within ninety days, the local authorities are to remove them. We cordially approve such measures being adopted, but in this country many would consider them rather arbitrary; but then, of course, we are supposed to be less free, as well as not being Republican. Provision is made for something like 13,500 miles of telegraph and telephone wires, 500 miles for arc lighting and power, and about 100 miles for glow lamps, and already some miles of the subway are in use.

THE ORIGIN OF THE PHYLLOXERA.—M. Zaborowski, writing in the *Revue Scientifique*, points out that all epidemics, whether among animals or plants are more destructive in countries where they have been recently introduced than in their ancient seats, where the more susceptible individuals have been in course of time eliminated, and where the existing individuals are descended from those of a more resisting character. Instances of this appeared in the ravages of the cholera in its earlier visits to Europe, in the deadly character of the small-pox among the Eskimos, etc. This consideration supports the view that the phylloxera is of American origin, and that the American vines have by a process of natural selection arrived at a high degree of immunity from the attacks of this parasite. He shows that the remedies proposed are not generally efficacious. Vines in low grounds may be saved by flooding, and those in sandy soils are not attacked. The chemical remedies have been found effectual where they have been carefully applied, but such application cannot be calculated on. The American vines yield in general unsatisfactory wines, but their use as stocks upon which superior European strains are grafted has proved the best means of dealing with the evil. Both the grapes and the wines thus obtained are free from rankness (*foxiness*), and compare favourably with those grown on old European stocks.

ARTIFICIAL RUBIES.—MM. Fremy and Verneuil have recently announced to the Academy of Sciences in Paris that they have at length succeeded in preparing artificial rubies, which are in all the points of hardness, colour, and crystalline form identical with those which are found in nature. M. Desclorzeaux has examined the crystals microscopically, and has expressed his opinion that they agree, when submitted to this test, with the properties of the real precious stones. The matrix in which the rubies are embedded is of a soft nature, so that the gems can easily be detached and rendered of commercial value. The discoverers hope that with larger apparatus and more improved appliances for obtaining a greater heat in the furnace in which the operation is conducted, that they will be able to obtain stones of a much larger size than those which they have already prepared. M. Fremy has been for several years engaged on this work, and as far back as 1877 succeeded in obtaining artificial rubies. He, in conjunction with M. Feil, heated to bright redness in a fire-clay crucible a mixture of alumina and red lead with a small quantity of potassium bichromate. The crystals formed were perfect in shape, but were frequently lamellar, and, being inclosed in a hard matrix, it was found impossible to extricate them. Alumina, according to the same authors, when heated to a high temperature with barium fluoride and a trace of potassium bichromate also yields crystals which are identical with natural rubies.

GAS HEATED KETTLE.

IN a previous number (p. 171) we described a gas-heated circulating boiler, made by Mr. Fletcher, of Warrington; and we now illustrate a kettle constructed by him on the same principle. In the case of the boiler we pointed out that its efficiency was very great, owing to there being copper rods, or studs, attached to the bottom of the boiler, so that the gas flame underneath could be in contact with surfaces less affected by the cooling influence of the water than the bottom of the boiler itself. The



important point being to prevent, as much as possible, the flame being cooled, so as not only to insure more complete combustion of the gas, but to obtain a quicker heating effect. In the case of the kettle now before us, the bottom is furnished with a series of curved heat conductors, as well as some projecting studs in the middle, as clearly shown in the plan view of our illustration. The principle of extending the heating surface, in the way described, is certainly a move in the right direction, and this is proved by the fact that with one of these kettles water can be boiled much more quickly than in any other kettle with which we are acquainted.

GLASGOW UNIVERSITY.—The Senate of the University of Glasgow has elected Professor Max Muller to the Gifford Lectureship of Natural Religion.

THE WEATHER GUIDES OF NATURE.

ALTHOUGH in these days of admirably-contrived meteorological instruments the signs afforded by Nature of the coming weather may not possess the importance they had in old days, when the publication of daily weather forecasts was undreamt of, they are by no means to be despised, and to people living in the country such signals have the advantage of being always come-at-able and of costing nothing, save the labour of observing them. It seems rather a pity that a little more systematic attention had not been given to this particular branch of meteorological science; for although Nature's weather guides do not possess dials and hands, or graduated tubes and so on, like the humanly-contrived instruments, there appears no reason for doubting but that, with care and judgment, they could be read off with considerable precision and readiness. To deal exhaustively with such a very wide subject would give ample employment to a large number of enquirers, and the writer therefore makes no pretension of giving in this article other than a brief recapitulation of the chief points in connection with natural weather wisdom which have come more or less under his own personal cognizance.

Beginning with the sun, it is a very common belief that when that luminary sets in so watery and white a glare that his disc can with difficulty be discerned, wind and rain may be expected. Wind also is considered to be portended when the northern sky is red at sunrise, or when the first indications of dawn appear above a bank of clouds, and rainy weather may be expected if twilight is unusually protracted. The old couplet—

> The evening red, the morning grey,
> Are the sure signs of a fine day,

and its equivalent—

> Red at night is the shepherd's delight,
> Red at morning is the shepherd's warning.

are widely known and self-explanatory.

The phases of the moon have been from very early times credited with exercising great influence on the weather, but this point is so debatable and difficult of satisfactory proof that it must suffice for the present occasion to say that when the moon's orb is brightly and clearly defined, fair weather is held to be presaged, and that a blurred and ill-defined look, especially about the cusps when our satellite is in her quarters, is, on the contrary, considered a bad sign, presaging wind and rain. A halo round the moon, with low clouds, generally means unsettled weather; with high clouds, wind.

In summer, when the stars seem especially bright and numerous, with well-defined twinkling, fair weather may be expected; and in winter the same appearances are held to denote frost. When the stars have a dull ill-diffused appearance, with scarcely-noticeable twinkling, wet weather may be looked for.

Coming now to terrestrial signs, we find that when remote objects appear near, and when distant hills, trees, and buildings show out sharp and clear against the sky-line, rain is portended. This clear appearance is sometimes very noticeable during the breaks occurring in showery weather. The rain seems to cleanse the air of all dust and floating particles, and the resulting transparency is sometimes quite remarkable. The way in which the smoke ascends from the chimney-top is a very widely-acknowledged weather portent. When it rises straight and column-like into the air, a continuance of fair weather may be expected; when it seems prevented from ascending and appears to be forced down on the surrounding housetops, the contrary is augured.

With respect to wind, most districts have some special quarter from which, if the wind blow, wet weather may be expected. The wind exercises a great influence on the carriage of sound; and when the wind is in the proper quarter it is sometimes astonishing how far the sounds of church bells, cock-crowing, and the barking of dogs may be wafted on the still country air. It is a common occurrence for people living in the country to connect certain sounds with certain weather. For instance, they may perhaps be able to hear the bells of some particular church only when the wind blows from that particular quarter: that wind may perhaps in that locality generally bring rain; so that they naturally regard the sound of those bells as the precursor of wet weather. A good example of this came to the writer's knowledge during a stay in South Devon. At one o'clock every day a gun is fired as a time signal from a battery in Plymouth Sound, and the report is carried far and wide over the neighbourhood. Now Plymouth enjoys a fair share of wet weather, the winds at such times being chiefly from the south-west, and the writer was informed that at several of the hamlets and villages lying miles inland to the north-east of the town, the sound of that one o'clock gun is regarded as a very good rain-portent.

It goes without saying that the rainbow implies showery weather, for that sky-spanning arc owes its existence to co-existent sunlight and rain. At times fragments of rainbows may be seen on isolated pieces of clouds. In sailors' parlance these *disjecta membra* go by the name of "wind dogs" or "wind gales," and are considered to portend wind squalls and rain, as is also said to be the case when the red hue seems to predominate in the ordinary rainbow.

Coming now to the animal world, we find many traits supposed to be due to weather influence. When cats indulge in frequent face-washing, rain is said to be foretold, and a sudden change in the existing state of the weather, whatever it may be, is considered to be presaged, when they appear more than usually restless. When cattle crowd together in the corner of their field, or when they stretch out their necks and sniff the breezes, when asses shake their long ears and bray, and when lambs are more frisky and playful than usual, wet may be expected. Virgil, too, in his "Georgics," credits swine with weather-wisdom, and reckons it a sign of wet when they "toss about with their snouts the loosened bundles of straw."

Birds are reckoned to be peculiarly sensitive to hygrometric changes, owing to the comparative dryness or moistness of the atmosphere readily affecting their feathers, and consequently their feelings. Perhaps it is the extra susceptibility due to its long tail plumes which makes the peacock indulge in its cat-like screams when rainy weather is approaching. High-flying swallows are, as almost everyone knows, a sign of fair weather; and when their insect prey flies low, and the pursuing swallows skim over the surface of the earth, sometimes even disturbing the stillness of some pond with the tips of their wings, wet weather is foretold. The omen is reckoned the same, too, when the farm-yard occupants are particularly noisy, when the cocks crow frequently and the ducks and geese are uproarious. Rooks and gulls, and other far-flying birds, deserve attention as weather guides, as they do not venture far from home when heavy weather is approaching. Storms at sea make sea-birds keep to the shore, and at such times they are often seen far inland. The times of arrival and departure of our migratory birds are also considered by some as indicative of the character of the approaching season. The early departure of our swallows and other summer visitors, and the speedy arrival of our winter migrants, especially field fares, are both considered to forebode a hard winter. The old rhyme—

Autumn hips and haws
Bring a winter nip nose

shows that a plentiful supply of berries, as food for these visitors, had as a prognostication the same meaning. The missel-thrush, one of the earliest of our song-birds, has earned a rather unenviable reputation as a bad weather prophet, and in some parts of the country bears on this account the name of the storm-cock, his loud jerky song, delivered from the top of some woodland tree, being generally held to presage a storm.

Amongst insects, the garden spider seems to take first rank as a weather-guide, the state of his web perhaps affording him the necessary clue to atmospheric perturbations, but as this point was fully described in a late issue of SCIENTIFIC NEWS (Vol. 1, page 172, First Series) it need not be repeated here. Ants, too, if they could be observed, would probably show themselves as little inferior to spiders in weather-wisdom, their solicitude for the welfare of their eggs making them especially mindful of coming storms. The bustle in one of their underground towns when a rain-storm is at hand, and the hurry-skurry to get all the eggs well down out of harm's way in the innermost recesses before the rain comes, would probably be a sight to be remembered if observation were only possible.

In conclusion, the writer would add that although many of the foregoing "signs" may not be of great practical value, the antiquity of the belief in some of them—for some of them were old when Virgil wrote two thousand years ago—makes the subject not only interesting, but worthy perhaps of more systematic and scientific consideration than it has hitherto received.

SELF-LUMINOUS BUOY.

AMONG the tried devices for rendering buoys luminous are lamps arranged to burn for a long time, phosphorescent mixtures, electric illuminators supplied with the current from the shore by means of a cable, and the more recent luminous paint, which absorbs light by day and gives it out at night. Compressed gas has been employed with great success, some of the buoys having been designed to carry six months' supply of gas and to serve as lightships.

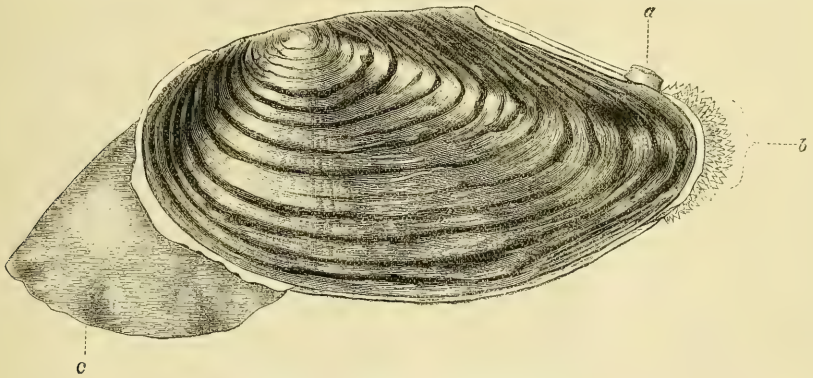
An illuminating apparatus has been designed as an auxiliary to bell buoys and whistling buoys. Based upon the generation of electricity by the agitation of mercury in ahigh vacuum or in gas of high tension, the self-exciting Geissler tube involves the same principle. The buoy represented in the cut is adapted to ring a bell by the rolling motion imparted to it by the waves. Advantage is taken of this motion to agitate mercury in the annular tubes placed in the upper portion of the frame of the buoy. The tubes are made very heavy and strong, and each contains barriers for causing friction of the mercury against the sides of the tubes.

To insure the action of one or more of the tubes at all times, they are inclined at different angles. A slight motion of the buoy causes the mercury to travel circularly in the tubes, and generate sufficient electricity to render the tubes luminous.—*G. M. Hopkins, in "Scientific American."*

Natural History.

FRESHWATER MUSSELS.

Like most common natural history objects mussels are of great interest from many points of view. Their large size at once attracts attention, and excites some amount of surprise; the shells sometimes measuring as much as seven or eight inches, by five inches. This is generally where the conditions are favourable, and where there is plenty of food. The freshwater or river-mussel can scarcely be said, however, to select food. The gills, which are in incessant motion, create a current, which draws into the mouth any matter, whether animal, vegetable, or inorganic, that may be in the vicinity, and are aided by the action of the tentacles. Decomposed animal and vegetable matters are the chief food of these molluscs; and in ponds, where there is plenty of this kind of food, in the shape of dead cats, dogs, or fish, and where the water is seldom disturbed, they become of a large size. During the summer months they are active, and crawl about the mud in which they live, leaving a more or less marked groove after them, locomotion being effected by a large fleshy somewhat triangular foot (see fig. 1). During the winter they bury themselves in the mud, and hybernate; even in the summer they do the same, should an unusual drought occur, and the mud be left dry.



Freshwater Mussel. Anodonta Cygnea.
a. Exhalent syphon. *b*. Labial palps. *c*. Foot.

As will be seen from the illustration, the animal is protected, like the marine mussels, by a shell, but of an entirely different shape. The shell of the freshwater mussel varies very much, according to its surroundings. There are six species living in English waters, all of which are very variable, the most common being the one illustrated.

The shells of some of them were made use of by Dutch painters for holding their colours, and at the present day they may be seen in the windows of colour shops, containing gold and silver for illuminating purposes.

If the shell be examined it will be noticed that the outside has a black skin, or periostracum covering it, while the inside is pearly. The black skin is generally supposed to protect the shell against being worn away or dissolved by the acids or gases sometimes present in the water. The inside portion from its nacreous or pearly condition is always attractive in appearance, this peculiar lustre being a good example of the interference of rays of light reflected from different surfaces, which is known by the name of diffraction.

One species of freshwater mussel is called the pearl-mussel, and has been known as such for centuries. They yield fine large pearls, and at one time the pearl fisheries of Britain were a source of considerable revenue to their owners, it having been stated that the value of the pearls from the River Tay, in Perthshire, during the years 1761 to 1764 reached £10,000.

Pearls are formed by layers of this nacre round foreign bodies, which have been introduced either through accident or design. The Chinese have long taken advantage of this irritability of the mussel tending to form pearls around foreign substances, and introduce various objects which they wish to become coated with pearl. In the museum of the Royal College of Surgeons may be seen the shell of a freshwater mussel from the neighbourhood of Ningpo, into which twenty-three plates of a white metal, each stamped with a figure of Buddha, have been introduced, and have afterwards been coated with a layer of nacre.

All the freshwater mussels develop pearls, but all are not valuable, being irregular, or faulty; their prevailing colour is white, but black, green, brown, and flesh-coloured, or pink ones, are occasionally found, the latter, when large and well-shaped, being the most valuable.

The development of the freshwater mussel is one of the chief points of interest. The eggs are generally laid in the later summer or autumn months, but they do not leave the mother-animal, being hatched in the branchiæ or gills. The development within the egg is introduced by an unequal segmentation, and results in the formation of a blastosphere with a large segmentation cavity. The embryo, which is partially ciliated, and rotates within the egg-membranes, soon acquires a ciliated velum and shell-gland. The shell is formed as a continuous saddle-shaped plate on the dorsal surface. From this plate the two valves are subsequently differentiated; on the dorsal surface they meet with a straight hinge-line. Each valve is at first rounded, but subsequently becomes triangular with the hinge-line as a base. At a later

period a beak-shaped organ is placed at about a right angle with the main portion of the valve; it is pointed at the extremity, and bears numerous sharp spines. After the shell has been formed, a new structure makes its appearance, known as the byssus-gland, which secretes an elongated cord by which the larva can suspend itself.

With the development of the shell, the mantle and the sense organs, the young mussel reaches its full larval development, and is now known as a Glochidium. These glochidia are very unlike the parent, so that when first discovered, they were thought to be parasites. They are very numerous during the winter months, being found in the branchiæ or gills of the parent, which have been compared in this respect to the "marsupium" or pouch of the marsupial animals—as the kangaroo, etc.

During the spring the parent ejects these larval glochidia, and when a fish swims by they attach themselves to the gills, fins, or other parts by means of the spinous processes, and then affix the byssus cord; they then become covered over by the growth of the epidermic cells, or skin of their host, and undergo a metamorphosis. While in this condition they can be carried for miles away by their host in its travels; this may probably explain the world-wide occurrence of freshwater mussels.

The first change that occurs is the disappearance of the byssus and byssus organ; shortly afterwards all traces of the sense organs become lost. The anterior and posterior adductor muscles now form at the two ends of the body. The mantle lobes then undergo great changes; and according to Braun, the permanent shell is formed on the dorsal surface of the parasitic larva in the form of two small independent plates. By the time the larva, or, as it is now, the young mussel, leaves its host, all its parts, with the exception of the generative organs, are developed. It then drops into the mud at the bottom of the water, wherever it may have been carried, and commences life independently.

This example of transformation undergone by the freshwater mussel is of particular interest. The changes or transformations which the young mussel undergoes are, in reality, the changes which have been brought about during very long periods of time, extending far back into geological ages. That the changes in the young are the abbreviated history of the organism is now generally accepted as a truth, and we learn from this that the ancestors of modern freshwater mussels probably lived in marine surroundings, had shells like the *glochidium*, and were attached by means of the byssus to a rock like the marine mussels. By some means or other, some specimens were introduced into freshwater, very probably by their attachment to some floating object. The modifiability of an organism is always at a tension when introduced into another element, and this change in the surrounding medium of the ancestral form brought about modifications in the structure of the animal and its shell, the transforming influence of the fresh waters in which it found itself having left their traces after a lapse of ages in the parasitism and metamorphoses of the young mollusc.

Freshwater mussels are a very ancient family, having come into existence at a very early stage of the world's history. During the period when our coal beds were being formed they were very abundant in the swamps which then existed; they have undergone many vicissitudes, and seen many changes in our earth. They have, however, survived, and live to tell their tale of evolution.

OLD ANTS AND AGED SPIDERS.

Dr. H. C. McCook, in an interesting paper lately read before the Philadelphia Academy of Sciences, and reported in the *Ledger*, gave an account of the life-history of a fine specimen of the spider, commonly known as the American tarantula. The animal was given to him in 1882, by Dr. Joseph Leidy. It was then apparently eighteen months or two years old, and it lived in captivity until July, 1887. At the period of its death, therefore, it must have been at least seven years old, and may have been eight, having thus attained the distinction of being the most aged spider known to science. How long this species and other spiders generally live in their natural habitat is not known, but human protection in the present instance probably aided to prolong life. It was kept first in a glass globe, and afterwards in a wooden box, with glazed sides and a sliding glass door at the top. One end was filled with dry soil, which was slightly compacted and heaped up. The other end was sparsely covered with earth. It was at all times liberally supplied with water, and its food consisted of live flies, grasshoppers, and locusts. During confinement the tarantula shed its skin several times, a process apparently attended with some danger, as it was during such a change the creature died; and once before, on a similar occasion, it was found apparently dead, although it afterwards revived. It is possible that it was too much exhausted by a long previous fasting to endure the severe strain which evidently is laid upon the organism in the act of moulting. The spring of 1887 was a backward one, and some difficulty was experienced in procuring insects for food from the immediate neighbourhood. The annual supply of grasshoppers and locusts was very late, and it may be that, had the spider been strengthened by a few weeks' generous feeding previous to its last moult, it might have been still alive.

In connection with the general subject of the prolonged life of insects, Dr. McCook stated that during a recent visit to Sir John Lubbock, at his house in London, he inquired after a queen of the fuscous ant, which he had seen in an artificial formicary six years ago, it being then nearly eight years old. He was told by his host that it had died the day before, having at the time reached the wonderful age of more than thirteen years. She was still attended by her circle of courtiers. Some of these were licking the dead queen, or touching her with their antennæ, and making other demonstrations as though soliciting her attention, or desiring to wake her out of sleep. It was certainly a touching sight to witness these faithful attendants surrounding the dead body of one who had so long presided over the maternal destinies of the colony, and seeking by their caresses to evoke the attention which never again could respond to their solicitations.

The Largest Oak in Germany.—The *Neue Preussiche Zeitung* announces that this tree grows in the manor of Kadien, two miles to the north of Elbing, on the Frischer Haff. The mean circumference of the stem is ten yards. It is hollow, and the interior is closed with a gate. The cavity is so roomy that a class of thirty-five boys of eleven and twelve years of age belonging to a neighbouring school were able to crowd into it at once. The tree puts out yearly a luxuriant crop of leaves.

The Fresh-Water Fauna of the Tanganyika Lake.—According to *Humboldt*, the examination of the recent fauna of this lake, effected by Tausch, proves a strange similarity to that of very remote regions. The snails, which possess a very decided marine habitus, have their nearest affinities in the Laramie formations of North America and in certain strata of the Upper Chalk of southern Europe.

Polydactylism in Man.—Dr. Anton Stuxberg, Director of the Natural History Museum at Gothenberg, writes that at Oerebro, in Sweden, there are now living a shoemaker and his son, each of whom has two efficient thumbs on both hands. A brother of the shoemaker and four of his children have the same peculiarity, but in these five persons the extra digit is useless. The mother of the two brothers had six toes. Of the maternal grandmother nothing is known in this respect, but the great-grandmother had six fingers on each hand. Polydactylism has therefore been hereditary for five generations.

Habits of Otters.—Mr. E. Price writes to a weekly contemporary to learn if otters are known to pursue rats? He found one in his barn, situate about two hundred yards from the nearest pond or watercourse; it must have entered the barn through a hole some twelve inches square. It escaped into the water and disappeared.

Discovery of Fossil Remains.—In a cavern near Rübeland, in the Harz, more than 1,000 kilos of fossil bones have been dug up, although only a part of the floor of the cavern has been examined.

A New Silk Moth.—Father Paul Camboué has observed in the interior of Madagascar an interesting silk-moth, which is named *Barocera bibindandy*. The caterpillars feed upon the weeping willow, and spin cocoons about 7 inches in length by 3½ in diameter.

Worms in Hens' Eggs.—Dr. E. Linton (*American Naturalist*) records the occurrence of *Distomum ovatum* in the white of a hen's egg from Wisconsin. Two cases of the enclosure of nematodes in hens' eggs are recorded in Pelleton's *Journal de Micrographie*.

Land-snails of Europe and America.—Dr. W. Kobelt, at the Wiesbaden Congress of German Naturalists, compared the land-snails of Europe, recent and fossil, with those of America. In modern times the two differ widely, but the miocene forms of Europe so resemble those of the West Indies and North America that these latter may be supposed to be descended from the former. Kobelt believes that the two continents must have been connected by land to the north of the Sahara.

A Stimulant for Vegetation.—According to the *Monde de la Science*, a solution of camphor in water stimulates vegetation and acts as a tonic for sickly plants. The *Flore Illustré* recommends that bouquets should be placed in camphor water, as they thus retain their beauty longer.

The Spring Note of the Cuckoo.—According to Mr. J. Rowell (*Newcastle Observer*), the note of the cuckoo, early in April, may be rendered as "Hoo, hooh, ooh, ooh."

TECHNICAL EDUCATION.—II.

Abridgment of Paper Read at the Society of Arts by Mr. Swire Smith on the Technical Education Bill.

(*Continued from page* 231.)

The modifications suggested would tend to lighten rather than to burden the tasks of the scholars, by making school work much more interesting than it is at present. Such instruction would supply the rudiments of a technical education for artisans, and would materially help all boys and girls, irrespective of their intended career, to be "handy." It would bring the day school into harmony with the workshop, and would prepare the scholars for the scientific and technical instruction of the night school, or for advancing into the secondary day school.

3. *Continuation Schools*—under School Boards and voluntary school managers:—

(*a.*) The standard subjects should be taught as at present, with the addition of drawing, modelling, elementary science, and manual instruction for boys, and needlework, cookery, and household management for girls.

(*b.*) Increased grants should be given for attendance and general efficiency, independent of the passes in standard subjects.

(*c.*) The admission should be free.

(*d.*) The deficiency of income over expenditure to be defrayed out of the School Board fund in the case of Board schools.

Under the Technical Instruction Bill the functions of the School Board should terminate with the organisation of elementary education, with the exception of such powers as School Boards already possess for conducting instruction in higher grade Board schools.

4. *Secondary Technical and Commercial Schools.*—

(*a.*) That power be given to municipalities or local Boards to establish, maintain, or contribute to the establishment and maintenance of secondary science and art, technical and commercial or agricultural schools and classes, including museums and art galleries connected therewith under the Science and Art Department.

(*b.*) That the limitation of building grants by the Government to £500 each for science and art be revised, and the grants increased.

(*c.*) That in addition to the Government grants at present made on the purchase of fittings for chemistry, for art furniture, examples, casts and copies, grants be also made on tools for working in wood, iron, and other materials. That in addition to loan collections and the grant of art reproductions at reduced cost, contributions be made to provincial industrial museums of original examples tending to advance the industries of the district in which such museums are situated.

(*d.*) That commercial subjects and modern languages be included in the subjects upon which grants are made by the Science and Art Department. That payments be so regulated as to lead to the encouragement of the teaching of advanced subjects of science, art, and commerce.

(*e.*) That power be given to municipalities by competition, or through the recommendation of head teachers in elementary schools, to provide scholarships, admitting artisan students from elementary schools to secondary technical schools for free instruction.

(*f.*) That power be given to remit the fees of deserving students attending secondary schools, the fees so remitted to be paid by the municipality. That municipalities may provide the necessary funds for taking advantage of the Royal and other exhibitions, under the Science and Art Department, whereby students of exceptional ability are admitted from provincial schools to the normal schools of science and art, and other higher schools or colleges. That special encouragement should be given by such means to the training of teachers.

(*g.*) That each municipality may appoint on its education committee, the Chairman of the Local School Board, the President of the Chamber of Commerce, and such other representatives and friends of education as may hereafter be determined upon.

(*h.*) That municipalities may, if they think fit, and subject to representation on the governing bodies, assist in the provision of accommodation for science and art purposes in existing endowed grammar schools, and in providing scholarships for deserving pupils from elementary schools tenable in endowed grammar schools.

(*i.*) That municipalities may supplement the accommodation provided with the assistance of Government building grants, by the addition of such special accommodation and apparatus as may be required for local trade teaching, such trade teaching to be maintained by the locality, without the assistance of the Science and Art Department.

Municipal Technical Night Schools—

(*a.*) That the secondary and technical day schools established by the municipalities, with their teaching staff and apparatus, be utilised for evening classes.

(*b.*) That municipalities may conduct evening classes *free of charge*, and that the Science and Art Department shall not require the payment of fees from artisans as a condition of the earning of grants, on the subjects on which grants are now or may be made by the Science and Art Department.

(*c.*) That municipalities may conduct, maintain, or contribute to the maintenance of evening technical classes, in which trade teaching may be imparted.

Existing Technical Schools and Classes in Science and Art, &c.—

(*a.*) That municipalities may, in accordance with the sanction of the trustees and governors of existing technical schools, take over such schools, either by purchase, rental, or gift, to be controlled and administered as if such schools had been built by the municipality.

(*b.*) That municipalities be empowered, subject to representation on the governing bodies to contribute to the maintenance of existing technical schools and classes, or to the maintenance of day or evening classes in specified subjects, that may be conducted by mechanics' institutions, or similar non-political and unsectarian agencies.

(*c.*) That municipalities, subject to representation on the governing bodies, may establish scholarships admitting students from elementary schools to technical schools under the Science and Art Department, not provided or controlled by the municipalities, and that municipalities may provide the funds necessary for taking advantage of the Royal exhibitions under the Department, enabling students of exceptional ability to be admitted from local schools to the normal schools of South Kensington, or other selected colleges, free of charge.

Technical Schools and Free Libraries.—That it be a recommendation to municipalities, wherever possible, to unite in one building or group of buildings the local technical school, museum, art gallery, and free library.

Higher Technical Scientific and Commercial Education.—For masters, managers, works-chemists, and other responsible persons; also for the training of teachers.

(*a.*) That building grants be made to university science colleges on the same conditions as to secondary science schools.

(*b.*) That annual grants for maintenance be made, as at present to the Welsh and Scotch colleges, the amount to depend upon the number of students in attendance, and the provision for their instruction.

(*c.*) That scholarships from secondary schools provided by State and municipal funds be tenable in these university colleges.

(*d.*) That grants be made by the Education Department in aid of elementary teachers who may be trained at such colleges.

General System of National Education—

(*a.*) That the organisation of public education in the United Kingdom cannot be considered satisfactory until public schools are brought into connection with each other by a series of steps leading from primary to secondary schools of the technical, commercial and classical types, and from these to the modern science colleges or the universities.

(*b.*) That for the effective control and development of such a system of national education a Minister of Education is necessary.

The above recommendations, if adopted, would enable the municipalities of the country, after the administration of elementary education by School Boards, to establish secondary Technical and Commercial Schools, of the character of those which have done so much to stimulate the manufacturing industries and commerce of other countries, types of which have already been founded and conducted with marked success in some of the towns of England. The schools would be attended in the daytime by students, from eleven or twelve to seventeen or eighteen years of age, who would receive a practical English education with the addition of modern languages, and supplemented by such art, science, and technical subjects as would be applicable to the wants of each manufacturing or agricultural district. It is to be hoped that a fair proportion of the students would be winners of scholarships from elementary schools. The classes would also be open to young men engaged in local industries, who would be able to obtain specific instruction in science, art, commerce, or technology.

Just as the elementary schools of a district would prepare the scholars for the secondary schools, so from these, by means of scholarships offered to talented students, there would be an open door to the South Kensington normal schools and the university colleges, which would also provide extended courses of higher instruction for employers and others of greater means and leisure.

Existing technical schools would need to be taken over or assisted by the local authorities, because experience has shown that it is impossible to bring the instruction within the reach of the artisan on a self-supporting basis. Yet it is upon the skill and knowledge of the artisan that our national prosperity so much depends, and, therefore, the fees must not be too high for the

workman who is able and willing to sacrifice his son's earnings by keeping him at school till he is fourteen or fifteen; while, on the other hand, the teaching must be so good that the wealthy employer will find it worth while to send his son to the local school. The son of the employer and of the workman will thus be found side by side at the same desk, and it is not likely that the mutual contact will injure the one or the other. Just as efficient teaching brings good grants, so it contributes powerfully towards its own cost, and in this respect the financial difficulty of giving to artisans the benefit of the best instruction will not be serious. Nevertheless, any deficiency between the income and expenditure would need to be met by public sources, the most appropriate being the local rates.

(*To be continued.*)

MIRAGE.

ONE of the most curious of meteorological phenomena is that known by the French as *mirage*, by the Arabs as *sirab*, by the Sicilians as *fata morgana*, and by the people of the German Baltic coasts as *kimmung*. Its English name, if it had one, would probably be "kimming," though one form of it is known by our sailors as "looming."

The essential feature of this phenomenon is that objects which are below the spectator's horizon, and consequently invisible in the ordinary state of the atmosphere, are seen sometimes inverted, sometimes upright, and either suspended in the air or as if reflected from a mirror laid on the surface of the earth. This illusion is most common in the Soudan, in the desert parts of Egypt, in the Sahara, Arabia, and Persia. The traveller sees at some little distance before him a tranquil lake, in which are reflected palm-trees, houses, and other prominent objects. He pushes on, in the expectation of finding water, the great desideratum in those regions, but finds the vision recede before him, or perhaps vanish altogether.

Similar illusions are witnessed at sea, always, however, in calm weather, and in curious contrast to the desert cases for the most part in high latitudes. Ships engaged in the whale-fishery have sometimes been seen and even recognised by means of the mirage when at very considerable distances. Perhaps the best-authenticated case of this kind is that recorded by Capt. Scoresby. He saw and identified his father's ship when it must have been more than thirty miles off, though he was not at the time aware that it was cruising in that region of the Arctic seas. It appeared to him as if inverted and suspended in the air.

One of the most curious forms of the mirage is that sometimes witnessed in the straits of Messina, especially near the town of Reggio. A strange assemblage of objects, some stationary and others moving, are described as having been seen, either in the air or on the surface of the sea. Minasi gives a rather sensational account of this phenomenon which has been copied as literal truth into a variety of works—even into treatises on optics. He writes:—"A spectator, on an eminence in the city of Reggio, with his back to the sun and his face to the sea, and when the rising sun shines from that point whence the incident rays form an angle of about 45° on the sea of Reggio, sees upon the water numberless series of pilasters, arches, castles, regular columns, lofty towers, superb palaces, with balconies and windows, villages and trees, plains with herds and flocks, armies of men on foot and on horseback, all passing in rapid succession along the surface of the sea."

This phantasmagoria is ascribed to the agency of the Fairy Queen, Morgana la Fata, of popular mythology. Now, here is precisely the difficulty. Such accounts are almost always so overlaid with imaginary embellishments that it is difficult to come at the actual facts. Of these cases at Reggio Captain Smyth in his work on Sicily observes:—"I never met with a Sicilian who had *actually seen* anything more than the loom or mirage, consequent on a peculiar state of the atmosphere; but which, I must say I have here observed many times to be unusually strong."

We have met with accounts of various phenomena said to have been witnessed in various parts of Britain and Ireland, which have been referred to the "second sight," or to other extra-natural agencies, but which have probably their substratum of fact in this same optical phenomenon. In the East the Arabs consider the mirage to be the work of sorcerers or of Djinns, who wish to entice a caravan out of the right track in the fallacious hope of meeting earlier with water and shelter.

But leaving superstitions on one side, there are good reasons why our accounts of the mirage should be exaggerated, if not distorted. The traveller in the desert, tormented with *real* thirst, as distinguished from the mere acquired craving for liquid so common in England, will naturally see a luxuriant landscape, where there is even the slightest indication of water and of shade. If we turn to the cause of the mirage we shall soon be able to distinguish in these narratives the truth from the marvels which have been superadded.

The whole matter, as explained by Monge, is a case of refraction. It results from the unequal density of different layers of the air, when they are rarefied by contact with the heated soil. The lowest stratum of the air is then the least dense. Hence a ray of light reflected from any elevated object passes through layers of air, which are gradually less and less refractive, and is again reflected from the lower surface of such a stratum, thus presenting to the eye an inverted image of the object, as if reflected in a sheet of water placed somewhere between its real position and the eye of the spectator.

As a matter of course the mirage, to the view of a cool judicious observer, neither tormented with thirst nor influenced by superstition can create nothing. It must merely present the images of objects which are really existent, although at a much greater distance than it would be supposed.

The cases when ships are seen suspended in the air are due to the same law of refraction. In the Arctic seas the layer of air in immediate contact with the water will be the coldest, and consequently the densest and most strongly refractive. Hence the rays of light reflected from the vessel are bent upwards.

Wollaston devised a method of exhibiting the mirage artificially. He looked along the side of a red-hot poker, at an object ten or twelve feet off. And about 3-8ths of an inch from the end of the poker an inverted image of the object was seen.

It need scarcely be said that the mirage can occur only in calm weather. Wind prevents the formation of denser or rarer strata of the air by mixing all up together, and consequently gives no scope for the effects of refraction above mentioned.

Reviews.

Animal Biology. An elementary text-book. By C. Lloyd Morgan. London: Rivingtons, 1887.

It is impossible to gain a clear idea of what "Evolution" means, without an orderly and accurate knowledge of some of the facts on which that great theory rests; for it is a scientific theory, and science rests wholly on facts. The methods of science are the methods of observing facts, of thinking about those that have been observed, and of verifying the conclusions arrived at. Here we have an excellent text-book, which introduces the reader to some of the most fundamental facts of animal biology. It puts before him the principal types, from the rabbit and pigeon down to the amoeba. It traces their development, describes them as they are, and gives an account of what they do—how they feed and breathe, and all their parts are nourished, and how they feel and move. Then by careful summaries of the most essential facts the reader is led to compare the types, to relegate each to its due place in the series, and to comprehend the nature of the relations which hold between them. At the same time the reader is warned that he must not merely take on trust what he is told; he must "repeat the observations and experiments . . . and conscienciously verify the inferences of his masters in science." "The student of science must learn his facts at first hand, and must regard books as guides to that object." And indeed this book is an excellent guide to that object.

Professor Morgan's plan of putting the higher types first, and devoting to them the larger portion of the work, is not usual; for most teachers of biology prefer to pass upwards in the series, beginning with animal life as manifested under its simplest conditions, and following it in its development through forms of increasing complexity. But the new plan is decidedly to be commended. Professor Morgan states that he has adopted it "because he has had in view . . . the requirements of those who intend to follow a medical career; and who will, he believes, after looking through such a course as is developed in this volume, be able to make a better start, and thereafter more rapid progress, in their study of human anatomy and physiology than would be otherwise possible.

Hitherto those who have studied for the London Int. B.Sc. and Prel. Sci., or for other similar examinations based on the type system, have had no simple text-book suitable for their use. This want Professor Morgan has supplied in a most satisfactory manner.

The book is written in a simple, clear, and most interesting style; it is well illustrated with outline sketches and diagrams which are very completely explained; the summaries and comparisons which occur at intervals will be of great service to the student; and finally there is a very good index.

Sixth Annual Report of the United States Geological Survey, 1884-1885. By J. W. Powell (Director).

In this volume we have the report of Mr. J. W. Powell, the Director of the United States Geological Survey, for the fiscal year 1884-1885, to the Secretary of the Interior, detailing the progress made during that time at the various centres from which surveying operations are being conducted throughout the United States.

During the year, 57,508 square miles of country were surveyed and maps thereof prepared, at an average cost of 3 dollars per square mile. The bulk of the work done was in the Appalachian and Missouri-Kansas districts, 15,000 square miles being also surveyed in the plateau region of New Mexico; comparatively small areas of Massachusetts, New Jersey, Texas, Yellowstone Park, and Northern California, go to swell the total, surveying in these districts having been only recently commenced. The reports of the four-and-twenty heads of divisions which follow Mr. Powell's report, being mostly formal statements of progress effected, are not of great interest to the general reader; but five of the departments have sent in accompanying papers, giving exhaustive details of their respective districts, etc., which are well worth attentive examination.

The first of these is by Capt. C. E. Dutton, concerning Mount Taylor and the Zuñi Plateau, a volcanic district to the north of Arizona and New Mexico. This paper is beautifully illustrated throughout, by the photo-lithographic process, and in special cases where it is desirable to secure accurate records of the rock formation, extraordinary trouble has been taken to accentuate the important features of the original photograph; for instance, in order to show clearly the columnar structure of a volcanic "neck," the following processes are undertaken: "From the original negative an enlarged positive or transparency was made. From this a still larger negative was taken; with the enlarged negative a silver print on paper was then made, and on the surface of the print a pen-and-ink drawing was traced. The drawing was then bleached and the silver print dissolved out, leaving only the penwork, which was reproduced on a greatly-reduced scale by photo-engraving." The next paper, by Messrs. Chamberlin and Salisbury, treats of the driftless area of the Upper Mississippi Valley, and is an attempt to account for the absence of glacial drift over a district of 10,000 square miles in the Upper Mississippi basin, the whole of the surrounding country bearing a great mantle of drift that has apparently been unable to spread over this favoured spot. The driftless character of this region has arrested the attention of many geologists of repute, from the days of Owen to our own; the remarkable feature of the case being, that the district which has been left untouched by the glaciation that prevailed all around is a broad tract lying in the very valley of the great river of the region, unprotected by any topographical barrier, that could have arrested the drift-bearing ice in its downward career on the slope toward the unglaciated basin. We cannot say that the solution of the mystery offered by the authors is entirely conclusive, which is hardly to be wondered at, considering the vast area of country and its contour, which have to be taken into account in speculating on a subject of such magnitude; but their paper is certainly a valuable contribution to the literature of a problem which has already puzzled such geologists as Owen, Daniels, Percival, Irving, and many others. The third paper on the "Quantitative Determination of Silver by means of the Microscope," by J. S. Curtis, describes an improved method of measuring the resultant silver-bead of an assay without removing it from the cupel; an important consideration where the proportion of silver is only about 0·00001 per cent., with ten grains as the quantity of the rock taken for assay.

With the space at our disposal, we can do no more than mention a paper by Professor N. S. Shaler, on "Sea Coast Swamps of the Eastern United. States," describing the causes of their formation, and the results

on the coast-line; and, finally, an exhaustive list of the flora of the Laramic Group, by Lester F. Ward, illustrated by some sixty large plates representing fossil leaves, mostly of dicotyledons, obtained from this formation.

Transactions of the Manchester Geological Society. Vol. xix. Parts xii. and xiii.

The former of these parts is taken up with the inaugural address of the President, Mr. Joseph Dickinson. The first part of this address treats rather briefly of the general progress of geology. He raises, however, some interesting questions. He asks if there is any instance that rock salt has been actually penetrated underneath the lias? He asks, why do the lowest geological formations ordinarily occupy the highest elevations above sea level? Why should rivers commonly flow from the lowest to newer formations?

On mining, that is, from a South Lancashire point of view, coal-mining, he expatiates at very considerable length. He mentions the very curious fact that at shallow depths, in very ancient workings, in the iron-ore of the Forest of Dean, spades cut out of solid wood have been found without any appearance of having ever been tipped with iron. After a reference to the work of Agricola on mining, written more than three centuries ago, he passes to his main subject, "Mine explosions and their prevention." A curious fact brought out is, that the mortality among copper, tin, and lead miners, who are in no danger from explosions, is greater than that among coal-miners at all ages. Between the ages of forty-five and fifty-five, for instance, it is almost exactly double. And yet the metal miners, unless we are very much misinformed, are intellectually and morally a class very much superior to the colliers.

The underground temperature at the depth of 50 feet is given as 50° Fahr., which is about the yearly average temperature of the air in the shade, at least in the South of England. In the coal districts, the mean rise of temperature on descending is 1° Fahr. for every 60 feet of depth. Consequently at the depth of 4,000 feet, which is taken as the maximum depth at which coal-mining is practicable, the temperature would be 110° Fahr.

The older safety lamps, the Davy, the Stephenson, and the Olanny, are now being rapidly superseded by the Mueseler, the "Protector," and the Marsent.

In Part xiii. the question is raised in how far the earth tremors observed in the neighbourhood of Sunderland are connected with the pumping of water from the magnesian limestone, and again whether the earthquakes which are said to have lately occurred in Lancashire are due to old coal-workings. A further question for examination is how far beneath the surface these tremors extend.

The bulk of this Part is, however, devoted to a paper by Mr. W. Clifford, on the Richmond Coal-fields, Virginia.

Worthy of Imitation.—The Russian Minister of Ways of Communication has appointed a special commission to select the best system of electric lighting for railway carriages. This is the result of a decision recently arrived at to render the adoption of the electric light compulsory upon the principal railway companies for all passenger trains. The experiments will be conducted on the Nicolaieff Railway, and are not expected to last more than a month. The South Russian Railway Company, it should be noted, has already adopted the electric light for all fast trains running between Odessa and Kieff, while it has been used in the special Imperial trains for some time past.—*Electrical Review.*

THE TIME IN WHICH WE THINK.

ONE of the most beautiful applications of electricity which has of late been made is its use in the study of psychological phenomena. And why, indeed, is not the subtile power by which time and space are being annihilated, and human labour rendered less irksome, the most proper agent to assist man in the study of facts of his own consciousness? In an elaborate article in the *Nineteenth Century*, Dr. J. McK. Cattell gives an account of the time-measurements of thought, made by means of a line drawn on a rapidly moving surface by a pen attached to the prong of a tuning-fork, vibrating at a constant rate, by means of electricity. By a delicate apparatus constructed on this principle, duration of time may be measured to the one ten-thousandth of a second. The writer above-named has found that the process of thought varies in its degree of rapidity in different individuals, children and old persons thinking slower than people of middle age, ignorant persons thinking more slowly than educated persons. In this way he also found he could measure the time it takes to perceive; that is, the time which passes from the moment when the impression reaches consciousness until the moment at which we know what it is. In his own case he found that it took 1-20 second to see white light, 1-10 second to see a picture, 1-8 to see a letter, and 1-7 to see a word. It takes longer to see a rare word than a common word, or a word foreign language than in our native tongue. It even takes longer to see some letters than others. "Will time," or time taken up in choosing, can be measured. It takes 1-13 second to judge between blue and red. To recall the name of a printed word takes 1-9 second, of a letter 1-6 second, of a picture 1-4 second. It takes less time to remember the name of a familiar word than a letter, though it takes less time to see the letter. The time of remembering can be measured. It takes 1-4 second to translate a word from one language to another when you are familiar with both. It takes 1-20 second longer to translate a word from a foreign language to your native tongue than it does in the other direction. We can think of the name of the next month in half the time we can think of the last month. It has been demonstrated that sensation does not travel through the nerves to the brain so fast as has been supposed. Its speed is not much greater than sixty miles an hour.—*Light and Heat.*

Decay Proof Fabrics.—A Belgian, residing in America, proposes to make fabrics almost proof against decay, no matter what their colour or texture may be. He has been studying the headbands of Egyptian mummies, which are invariably found in a wonderful state of preservation, and he discovered that the substance with which they are impregnated is a kind of resin. He then made a series of experiments with the substance extracted from birch bark, to which the peculiar aroma of Russian leather is attributable. In the end it was discovered—so the story goes—that the green tar which was left over after the oil used in tanning had been extracted from the white bark of the birch tree would yield neither acid nor alkaloid, and that it would, in solution with alcohol, form a liquid of remarkable fluidity, but with the power of resisting, after once drying, even the action of alcohol itself. This is the substance which is to unite with the most delicate or brilliant colours, which will not impair the softness of the finest fabrics, and yet will make them nearly indestructible.

Abstracts of Papers, Lectures, etc.

THE ROYAL INSTITUTION.

The evening discourse, on the 2nd inst., was given by Dr. M. Tidy on poisons and poisonings. The meaning of our word toxicology was first referred to. From the Greek, a bow, the word came to be transferred to that shot from a bow—the arrow—and then that which was put on the tip of the arrow to ensure the death of a foe. The poison from the fang of a serpent was probably the first used. The early mythological, and what we call classical allusions, seem to point to this. Dioscorides was the first to use the word for an effect on the body, so far as ancient writings have come down to us, and he used it in reference to the knowledge of how to smear arrows so as to secure death. The whole subject of toxicology was one of great historic interest. We may grow wiser and yet more wicked. So far as any historic records helped us, poisons were first used in open and declared warfare, as we use our torpedo-boats and other recognised implements of death in our nineteenth century civilisation. The more subtle use of curari belonged to a late period of poisoning. The rough early man poisoned his recognised fighting weapons; it remained for a more refined age to mix the chemical drug in the cup of so-called amity. Several bottles on the table were referred to as containing sufficient in an ounce to clear off a village or a town. The early classic allusions to poisons and their emblems in Greek mythology were referred to, and also the many mid-age and English mediæval notions, such as that to taste the blood of a red-haired woman was sure death. Even so late as Blumenbach, in the last century, the question of blood being poison was unsettled. He induced a pupil to take 7 ozs. of bullock's blood while his symptoms were watched. What a grand field for the historic toxicologist did the history of Italy open up, from Nero to the Borgias and later worthy heroes. But there was a very serious legal side to the question. The law had never defined what a poison was. In every law case it was left to the expert to say what was a poison. The popular notion was an utterly false one. The real point was to decide what was not a poison. So much depended on conditions. This was illustrated by many experiments, and the lecturer then proceeded to point out that a poison might cause local death which did not cause death of the whole body. Or a local death might in time lead to a want of "health"—"wholeness"—which caused death. Considerable time was given to the question of the effect of chemical action on the hæmoglobin, and the effects of various re-agents on it were shown. In the course of the lecture a part of the hat of Mr. Briggs, who was murdered by Müller, was subjected to the spectroscopic test, showing blood-staining in the midst of all the dirt. The hat had been in the lecturer's possession since the trial.

ROYAL GEOGRAPHICAL SOCIETY.

Mr. Robert Gordon, C.E., read a paper on the 27th ult. on "The Ruby Mines of Burmah," stating that he surveyed the ruby mining district north of Mandalay when the concessionaires, Messrs. Streeter, were requested to send representatives to the mines. The country was described, and a railway, which was stated to have already brought about economic changes of the highest importance, was pointed out as possessing great interest as the first instalment of the great iron highway for British commerce to South-Western China. He described in detail the country from Mandalay to the ruby mines, noticing its flora, fauna, diversity of race among its peoples, and its general features, speaking of it as representing hill and vale, the ranges of hills varying from 6,000 ft. to 8,000 ft. in height. The principal villages of the mining district were Mogok, Kathay, and Kyatpyen. No permanent mining works of any value existed, but numerous artificial water-channels were carried with easy slopes on the hillsides, the ravines being crossed by temporary aqueducts on bamboo framing. The mines were of three kinds—the first, which was of the least importance at present, but which might be the most valuable in the future, consisted of workings in fissure veins of soft material found embedded in the crevices of the hard rock, caused by shrinkage in long past ages. It was probable that volcanic action accompanied the upheaval of these mountain ranges, and that the already formed rubies were thrown up with a matrix of complex structure, since disintegrated by long weathering, together with the metamorphic rocks clothing the skeleton of the old mountain limestone, whose ribs still protrude. There was no sign of any recent volcanic action in the neighbourhood; and the corundum was now found distributed through the clay formed from the breaking down of the gneissic rocks, and also in layers or beds in the valley bottoms near the river, apparently discriminated and arranged by water action. The crevices in the older rocks gave origin to cave mines, which were called "loss," where the soft earth was excavated in a primitive fashion and on a small scale. The second class of mine was called "myaw," or washing, and corresponded, but on an insignificant scale, with the hydraulic mining in California. The water was conducted by the channels to the lower hillsides, which consisted usually of the softer remains of the secondary rocks in reddish or lighter coloured clays, containing rubies and sapphires, though few and far between. The clay was cut into thin slices with a gardener's spade, and washed from the funnel-shaped excavations through flumes or open timber channels, where the clay was dissolved away or carefully examined for the stones. No attempt had been made to wash the hillsides by water under pressure. The third and, at present, the most important class of mines was found in the flatter lands of the valleys, where, whatever be the absolute height of the ground, or whether in the neighbourhood of Mogok, or Yay-Boo, or Kathay, or Kyatpyen, at depths varying from 10 ft. to 30 ft., there was found a layer of corundum from a few inches to a few feet in thickness. It was difficult to account for the existence of this layer of nearly pure corundum lying on a bed of earth in which no stones were found, and covered by a similar layer of porous earth.

GLASGOW PHILOSOPHICAL SOCIETY.

At the meeting held on February 22nd, Mr. Thos. Gray, F.R.S.E., exhibited and described an improved form of seismograph. He also read a paper on "The Use of Seismometric Measurement in Earthquake Investigation." This was an apparatus, he said, suitable either for observatories or private use. It gave a record of the motion of the earth in the form of the vertical and two

rectangular horizontal components, which were written in ink on a long band of paper, which under ordinary circumstances is being slowly led forward by means of clockwork. On the occurrence of an earthquake the paper feed is automatically greatly increased, and again after a few minutes slowed to its ordinary rate; the automatic apparatus being adjusted by the clockwork itself, so as to be ready for another earthquake. Any number of successive earthquakes could thus be recorded on the same ribbon without trouble to the investigator. Time is marked by means of an accurate timepiece on the paper ribbon every five minutes, and a distinguishing mark is made every hour. Mr. A. W. Meikle read a paper "On the Measurement of Electric Currents by the Electrolytic Deposition of Copper." Dr. James Colville, M.A., submitted the following motion:—"That a philological section of the Philosophical Society be formed, and that a committee, to be afterwards nominated, be appointed to draft a constitution for the section."

GEOLOGICAL SOCIETY OF LONDON.

At the meeting held on February 29th, W. D. Blanford, LL.D., F.R.S., President, in the chair, the following communications were read:—

1. "An Estimate of Post-Glacial Time." By T. Mellard Reade, Esq., C.E., F.G.S.

The author showed that there exists on the coasts of Lancashire and Cheshire an important series of Post-Glacial deposits which he has studied for many years. The whole country to which his notes refer was formerly covered with a mantle of low-level marine Boulder-clay and sands, and the valleys of the Dee, Mersey, and Ribble were at one time filled with these glacial deposits.

These glacial beds have been much denuded, especially in the valleys, where the rivers have cleared them out, in some cases, to the bed rock. Most of this denudation occurred during a period of elevation succeeding the deposition of the low-level Boulder-clay. On this eroded surface and in the eroded channels lie a series of Post-glacial beds of a most interesting and extensive nature. They consist of estuarine silt and *Scrobicularia*-clay covered by extensive peat-deposits, containing the stools of trees rooted into them. Upon these lie, in some places, recent tidal silts, and on the coast margin blown sand and sand dunes. The series of events represented by the denudation of the Low-level Boulder-clay and the laying down of these deposits is as follows:—1st, elevation succeeding the Glacial period, during which time the Boulder-clay was deeply denuded in the valleys. 2nd, subsidence to about the 25-feet contour, when the estuarine silts and clays were laid down. 3rd, re-elevation, representing most probably a continental connection with the British Isles, during which time the climate was milder than at present, and big trees flourished where now they will not grow. 4th, subsidence to the present level, the submersion of the peat and forest-beds, the laying down of tidal silt upon them, and the accumulation of blown sand along the sea-margin, extending to a considerable distance in an inland direction.

It was estimated, from a variety of considerations, that these events, all posterior to the Glacial period, represent a lapse of time of not less than 57,500 years, allotted as follows:—40,000 years for the elevation succeeding the Glacial period measured by the denudation of the Boulder-clay in the valleys, 15,000 years for the accumulation of the estuarine silts, clays, peat, and forest beds, and 2,500 years for the blown sand.

2. "Note on the Movement of Scree-Material." By Charles Davison, Esq., M.A. Communicated by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S.

The author noticed the frequent high angle of slope of screes, and called attention to Canon Moseley's observations on the downward creep of lead on the roof of Bristol Cathedral, and his subsequent experiment, and stated his belief that stones free to move on the surface of a scree must be affected in the same manner. This he proved by experiments, the result of which he described.

These experiments showed that stones do move downwards, owing to alternate contraction and expansion, the movements accompanying or occurring a short time after the change of temperature, that the descent is greatest on days of bright sunshine, interrupted frequently by passing clouds, and that rain slightly increases the rate of descent.

A description was given of a scree on Hindscarth, Cumberland, in which the stones lie with their longer axes pointing down the slope; and it was pointed out that the movement of the stones in the way described would cause the surface-stones to fall off those on which they rested, and that others would be dislodged during their descent. A numerical estimate was then made of the total amount of movement produced on a scree of a certain size by expansion and contraction of the surface-stones, and after alluding to the relative efficiency of this and other agents upon various screes, the author concluded by pointing out that in the case of the moon this might be almost the only agent at work.

3. "On some Additional Occurrences of Tachylyte." By Grenville A. J. Cole, Esq., F.G.S.

An intrusive sheet, some 8 feet thick, among the basalts of Ardtun Head in Mull, has selvages of tachylyte. The specific gravity of the glass is 2·83, and in other respects it resembles the examples already described from the west of Scotland.

An analysis of the Ardtun spherulitic tachylyte shows it to resemble that of Beal in Skye, having 53 per cent. of silica and nearly 6 per cent. of alkalies.

An occurrence of tachylyte at Kilmelfort, Argyll, was noted, and a description given of an example of great beauty from the Quiraing in Skye. The latter rock shows, in section, a light-brown translucent glass, with abundant cumulites and small brown spherulites with radial structures.

Near Bryansford, County Down, in Ireland, a basalt dyke occurs, the selvage of which must have originally resembled the tachylyte of the Quiraing.

In conclusion, the well-known variolite of the Durance was cited as a rock of basic character, comparable, in its perlitic and spherulitic structures with the acid "pyromerides," both types having alike suffered from secondary devitrification.

4. "Appendix to Mr. A. T. Metcalfe's paper 'On Further Discoveries of Vertebrate Remains in the Triassic Strata of the South Coast of Devonshire, between Budleigh Salterton and Sidmouth.'" By H. J. Carter, Esq., F.R.S. Communicated by A. T. Metcalfe, Esq., F.G.S.

A microscopic examination of certain calcareous pellet-like bodies, containing plates possessing a bony structure, and referred to in Mr. Metcalfe's paper in the Society's

Journal for May, 1884, revealed the fact that the plates resembled the scales of the Bony Pike, and also the scales contained in certain Liassic coprolites which were identical in appearance with the Triassic pellets. The author concluded that the latter were the coprolites of Triassic amphibians which fed upon the same kind of Ganoid fishes as the Ichthyosaurs of the Lias.

EDINBURGH ASSOCIATION OF SCIENCE AND ARTS.

On February 20th, Mr. F. T. Shand read a paper on "Modern Blasting Agents" before this Association. He said there were at present over fifty explosive mixtures in use. He discussed the requirements for a good blasting agent, and gave a list of the comparative powers of the usual blasting substances, which showed that blasting gelatine exerted most force. The power depended on the quantity of the gases generated and the rapidity with which they were produced. He spoke of the various purposes to which the chief blasting agents were applied, and showed the suitability of blasting powder for quarrying, as it was comparatively slow in exploding, and broke up the rock without shattering it to fragments. Though it had many defects, no substitute for it had been produced where a mild agent was wanted. Mr. Nobel's work in producing nitro-glycerine and dynamite was described, and the lecturer next spoke of the mode of the manufacture of dynamite and of blasting gelatine at Ardeer, in Ayrshire. The manufacture of the gelatine was dangerous, but once made it was the safest of explosives. Dynamite was most suitable for blasting hard rock, and as it gave off very little fumes it was a valuable agent for blasting in mines. It was not liable to spontaneous explosion, and temporary contact with water did not spoil it. He pointed out that all these compounds could only be exploded by detonation, and not at all by mere ignition. Blasting gelatine was fifty per cent. stronger than dynamite, and five times stronger than blasting powder. Owing to its cost it had been superseded for mining purposes by gelatine-dynamite, which, while cheaper, had all the good qualities of blasting gelatine, except that it was not so powerful. He next showed that for such work as tunnel-boring through hard rock economy was secured by using the stronger explosive agencies in preference to blasting powder. The lecturer also described the water cartridge now in use in coal mines, which gives off no flame when exploded, and thus obviates gas explosions in fiery mines.

BRADFORD SCIENTIFIC ASSOCIATION.

Under the auspices of this Society Mr. G. Field gave on February 20th a free lecture in the Museum, on "British Birds." After mentioning that comparatively little was known on the subject of ornithology a century ago, the lecturer said that since that time much had been done by writers and collectors to spread knowledge on the subject. There were believed to be 1,500 specimens of birds. Of these 400 were British birds, of which 300 were residents and 100 migrants. Birds were divided into six classes by reason of differences in their feet. Firstly, there were a number of birds which were know as raptors, others were known as perchers, and there were also climbers, rasores, waders, and swimmers. The lecturer described the differences in the formation of the feet which distinguished the various classes, and pointed out the peculiar suitability of the construction of the feet to the wants of the birds. He then described at length the differences in the form of bill, which indicated the method of their feeding and the matter of their food. Going on to treat of wings, he stated that no two species of birds fly in the same manner, the style in which they flew depending upon the texture of the wing, feather, and tail. A long and acutely-pointed wing was essential to long-continued flying. Mr. Field then dealt briefly with the varieties of the food of birds and the differences in the formation of their digestive organs, and said they all knew their food by instinct, and shunned what was poison to them. He then dwelt upon the peculiar methods adopted by various kinds of birds in building their nests.

THE ROYAL SOCIETY OF EDINBURGH.

Mr. James S. Grant Wilson, on February 25th, read a communication on bathymetrical survey of the chief Perthshire lochs, and their relation to the glaciation of the district, in the course of which a detailed description of the physical features of the Lochs Rannoch, Tummel, and Earn was given, and the intimate connection between the different rock basins occupied by these lochs, as well as the glaciations of their respective districts, was also fully dealt with. In connection with this part of the paper, it was mentioned as a new fact in the glacial history of Scotland that during the great ice age the centre of the iceshed in the district of Rannoch did not coincide with the watershed of this part of the country, but lay between Lochs Rannoch and Tummel. Mr. Henry M. Cadell, of Grange, contributed the results of "Experimental researches in Mountain Building," designed primarily to throw light on the remarkable geological structures recently discovered by the Geological Survey in the North-west Highlands. The experiments were divided into three series. The object of the first was to explain the behaviour of stiff strata when pushed horizontally over an immoveable surface; and of the second, mainly to ascertain, if possible, how low-headed folds or "thrust planes," which had been proved to exist abundantly in the North-west Highlands, might have originated, and to trace their connection between "fan structure" and other phenomena observed in mountain systems of elevation. The third set of experiment had been conducted on the principles suggested by those of Professor A. Faure, of Geneva, of placing layers of clay on a stretched india-rubber band, and by allowing it to contract, to produce miniature Alpine ridges by the wrinkling up of the surface of the clay. The experiments, the result of which were embodied in the paper, had been attended by gratifying success. The other papers read were by Professor Tait, on the Duration of Impact, communicated by Mr. W. Peddie; and by Dr. Ernst Stecher, on Contact-phenomena of some Scottish Olivine-diabases, read by Mr. B. N. Peach.

SOCIETY OF CHEMICAL INDUSTRY.

At the meeting held on the 5th inst. Mr. Alexander M. Chance read a paper on the "Recovery of Sulphur from Alkali Waste." The author said that so far back as 1837 the late Mr. Gossage commenced his long and careful investigations of this attractive but perplexing subject. Since that time many other chemists have devoted much time, thought, and money to this object, but hitherto no process for the recovery of the sulphur lost

in the alkali waste, produced in the manufacture of soda by the Leblane process, has been sufficiently successful to be generally adopted. At a cost of over £10,000, and after two years' hard work, the firm with which the author is associated conclusively proved that, by means of Messrs. Schaffner and Helbig's process, the sulphur lost in the vat waste might be recovered as sulphuric acid, at a cost to the alkali maker equivalent to about 3d. per unit of sulphur per ton of Spanish pyrites, as compared with 6d. per unit then being charged to the alkali trade by the Pyrites Companies. But the Pyrites Companies at once dropped their price to 3d. per unit, and so made it cheaper to throw the sulphur into the waste heap than to recover it. In 1883 C. F. Claus took out a patent for obtaining sulphur from sulphide of hydrogen, mainly with a view to purify coal gas. But the author thought the process might be applied to the recovery of sulphur from alkali waste, and after five years' hard experimental work he has perfected a process. The method consists in mixing sulphuretted hydrogen, obtained by passing a current of lime-kiln gases into a cream of water and alkali waste, with a regulated quantity of air, and sending the mixture through a layer of anhydrous oxide of iron, which, by the heat generated by the reaction itself, is maintained at a dull red heat, the oxide of iron itself undergoing no change. Free sulphur, accompanied by vapour of water, passes off, the free sulphur being obtained in the fused or sublimed form, according to the temperature of the kiln and of the depositing chambers. The main difficulty consisted in obtaining sulphuretted hydrogen free from the inert nitrogen contained in the lime-kiln gases; the details of the ingenious method by which this problem was solved are, however, too technical for the general reader.

It is estimated that by this process about one hundred thousand tons per annum, of sulphur could be recovered, which quantity, after supplying the entire home requirements, would leave from 60,000 to 70,000 tons available for America, into which country crude brimstone is admitted free of duty. The quantity of pyrites used exclusively for making soda by the Leblanc process, the sulphur of which is now thrown away in the waste, is estimated at about 300,000 tons a year, amounting to one-half of the whole quantity imported.

THE VICTORIA INSTITUTE.

On March 5th an interesting paper was read by the Rev. Dr. Walker, F.L.S., F.E.S., on the distribution of the butterflies of Southern Asia, the "Oriental Region" of Sclater and Wallace. The lecturer gave a condensed and lucid survey of the characteristics of the Lepidopterous fauna of India and the Malay Islands, in accordance with the researches of Wallace, Distant, and Moore, superadding acute observations of his own. He points out that the Eastern tropics possess by no means such a variety of species of butterflies as does South America, and is of opinion that many of the Asiatic and African kinds have a wider range and distribution across their continents than is the case with the same proportion of species in the Neotropical region, which are confined to the limits of one valley or mountain range, not occurring outside or beyond.

He resolves the splendid genus *Ornithoptera* into three groups. Dr. Walker admits the phenomena of "mimetism" or "mimicry," but does not feel able to discuss the reasons for its occurrence in the economy of nature.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

WHAT KIND OF LEVER IS AN OAR?

"Athletic," in his letter which appears in your issue of the 2nd instant, specifies the case of an oar whose inboard and outboard lengths are, respectively, as 1 : 3. He finds it difficult to reconcile the "common theory that (in the case specified) the power would be ¾ of the resistance," with "the new theory that the power exerted must be three times the resistance." Permit me to point out that the power exerted will be the same whether we consider the oar to be a lever of the first or of the second order, *i.e.*, whether we consider the rowlock as a moving fulcrum, or the blade as a stationary one, and the two theories quoted are false if taken in the sense which the words appear to convey. But this is a matter of expression, so far as "Athletic" and I are concerned. I think I see what he is driving at.

Now, when the oar is pulled, the boat is moved, and the semi-resistance R of the boat is always exactly the same as the propelling force at the rowlock, and with an oar of given dimensions bears a constant ratio to P, as also does S. Suppose that the boat be moored, and the oar pulled. I grant that the oar will now be "harder to pull"—not because the fulcrum is altered in position, but because the boat's resistance to motion cannot now be overcome, and the more laborious work of forcing the water astern is now being done; power expended faster, and pressure at rowlock correspondingly increased.

I do not see that the "advantage" or "disadvantage" of the power affords the best criterion as to the order to which a lever may belong, but the relative positions of fulcrum, weight (resistance) and power should determine this. It is, however, not always easy to locate the weight and the power, as in the present instance, where we have the choice of two positions (rowlock and blade-end) for the resistance, and thus the statement that the fulcrum of a lever is that point about which the moments of power and resistance are equal" is useless to us because we are not decided as to *where is* the power or the resistance, and so cannot determine their moments. But it appears to be quite possible to definitely locate the fulcrum, and this being done, the definite location of weight and power is self-evident. I am unable to refer to the *Philosophical Magazine*, but I would submit the following method of locating the fulcrum from "Ausa Dynamica," p. 66:

"The Rev. T. K. Abbott, F.T.C.D., * * * * appeals to the concise practical criterion of a fulcrum, which is, that it is the point in the lever to which, if the 'power' be applied, no effect is produced. Now, if the rower's hand were applied to the oar at the rowlock no effect would be produced: but if it were applied to the oar at the blade an effect *would* be produced; therefore the former place is, and the latter is not, the true fulcrum of the oar for the rower sitting in the boat."

Therefore, I would add, the oar is a lever of the first order.

Wm. Jno. Tennant.

COLOURED WORDS.

The following translation of a passage in Goethe's "Campaign in France in 1792" occurs in Professor Creasy's "Fifteen Decisive Battles of the World." It is interesting inasmuch as it tells us that the celebrated German was susceptible to sensations very similar to those in the cases mentioned recently in Scientific News, where different noises brought different colours before the vision. Goethe, who accompanied the allied army out of curiosity, just before the battle of Valmy rode forward alone in the direction of the French position in quest, apparently, of "the cannon fever" of which he says he "had heard so much." He arrived, he says, "quite in the region where the balls were playing across me; the sound of them is curious enough, as if it were composed of the humming of tops, the gurgling of water, and the whistling of birds." He continues:—"In the midst of these

circumstances, I was soon able to remark that something unusual was taking place within me. I paid close attention to it, and still the sensation can be described only by similitude. It appeared as if you were in some extremely hot place, and, at the same time, quite penetrated by the heat of it, so that you feel yourself, as it were, quite one with the element in which you are. The eyes lose nothing of their strength or clearness; but it is as if the world had a kind of brown-red tint, which makes the situation, as well as the surrounding objects, more impressive. I was unable to perceive any agitation of the blood; but everything seemed rather to be swallowed up in the glow of which I speak. From this, then, it is clear in what sense this condition can be called a fever. It is remarkable, however, that the horrible, uneasy feeling arising from it is produced in us solely through the ears; for the cannon-thunder, the howling, and crashing of the balls through the air is the real cause of these sensations." W.

THE "SCREECHING WATER-BEETLE."

Amongst the many inhabitants of my aquarium is a small aquatic beetle which, when taken from the water, often emits a sound somewhat resembling a piece of paper drawn over the large teeth of a comb. Its name (the only one I know it by) is the "screech-beetle," and I am at a loss to discover its scientific title. It swims with an easy, gliding motion, and is exceedingly fond of concealing itself among shells, stones, etc. The legs are fringed with hairs, and each wing-case has a black mark on it; a small bubble of air is generally seen attached above the tail. It will eat small worms, and is about an inch long. I should be obliged to any of your correspondents if they would tell me the scientific name of this species. F. P. P.

HEIGHTS OF WATERFALLS.

In the interesting list of the highest waterfalls given in the number of the SCIENTIFIC NEWS for 2nd of March, there is an addition required of the "Yosemité Fall," in Yosemité Valley, California. This fall, which I have seen, is a high leap of 1,500 ft. (the highest in the world), followed by a second leap of 400 ft., and a third of 500 ft.; the walls of the valley being more than half a mile in vertical height. The quantity of water in the fall is comparatively small, the width at top being only about 30 ft.; and the result is that the water of the great fall is floated about by the wind almost like a gauze veil, producing specially lovely effects in bright sunshine. W.

THE TEMPERATURE AND RAINFALL OF 1887.

In answer to "A Member of the Liverpool Astronomical Society," I beg to state that my place of observation is Handsworth, Birmingham. As I duly appended it to my letter, the fault of its omission lies with the printer—not with me. B. A.

ANSWERS TO CORRESPONDENTS.

M. C. V. MACLEOD.—Thanks for communication. We are devoid of the prejudice to which you allude, but we are unable to insert your article, as it is too speculative and not sufficiently accurate.

EFFECTS OF THE ATMOSPHERE ON BRICKS.—Mr. G. R. Burnell, writing to the *Architect*, shows that the influence of the atmosphere upon bricks, etc., to depend both upon the composition of the clay and on the degree of burning. Portions of carbonate of lime are converted into quicklime, and, when wetted, expand and disintegrate the mass. Both brick and stone are acted upon most rapidly where there are frequent changes from dampness to dryness. The foundations of buildings do not suffer as much as parts of the wall from one to three feet above the surface.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

SPRING BALANCE.—Mr. E Edwards, on behalf of M. L. Martane, Paris, France, has patented a spring weighing scale. Two springs of exactly the same form are suspended from a fixed beam and carry the scalepans. Each is provided with a pointer, and the standard is graduated to serve as a check against the use of false weights. Two sets of such spring scales may be carried by the same standard, and in some cases a single spring may be used, the reading being shown by the graduations.

LIFE-SAVING SEAT.—Mr. J. G. Willcox, 2, Clyde-terrace, Southampton, has patented a life-saving seat. The seat is mainly composed of segments hinged together on the outer side, and when shut together form the required seat. The deck seat is supported by legs, which are made to turn back or slide up, and when used as a life belt, the seat is turned inside out, and in that form can be placed round the body, elastic fastenings being provided on the inside for holding the belt in its place. Shoulder straps are also provided, which cross over each shoulder.

REPEATING WATCH.—Mr. J. Robinson, Church Street, Maryport, Cumberland, has patented a watch. The keyless mechanism is modified so that on winding, the number of clicks made by a spring pawl on a toothed wheel will indicate the time since the watch was last wound, and thus give the time in the dark. In the arrangement described the pinion on the winding stem has twelve teeth, and carries a pin actuating a lever, every revolution of which is equivalent to twelve minutes. The lever strikes a gong, five taps being given for each hour. A number of pins for actuating the gong lever may be mounted on the face of a wheel driven by the pinion.

COFFEE AND TEA POT STRAINER.—Mr. A. H. Bowman, Grand Promenade, London, has patented a coffee and tea pot strainer. In carrying out this invention a cap with a flange is provided, which is preferably made by stamping out fine wire gauze, the cap being of sufficient diameter to cover the fixed strainer, and concaved in relation to the same in order to present a larger straining surface than that possessed by the fixed strainer. Fixing wires attached to the strainer are provided; they pass through the fixed strainer, and are made to protrude through the outer end of the spout, when they are pulled until the flange is brought close up to the inner surface of the pot, and then turned back upon the spout, and retain the flange in such a position.

AUTOMATIC VALVE.—A valve for inflating life belts has been patented by Mr. R. D. Kay, 275, Catherine Terrace, Latchford, near Warrington, Lancashire. The object of this invention is to produce a valve for inflating life belts, boxing gloves, etc., which opens and becomes automatic in its action, upon the user depressing with his mouth the front portion thereof, thus permitting the air

to enter the article to be inflated, and on being released, instantly closes and prevents the return of the air. The valve is formed of two jaws, hinged together about the middle, the first portion remaining open when the valve is not operated upon, while the back portion closes by the action of a spring suitably employed, which on the front portion of the valve being pressed together by the action of the mouth will allow the orifice of a tube leading to the article to open.

SOFTENING WATER.—An apparatus for softening water has been patented by Mr. C. E. Gittens, 100, Fenchurch Street, London. The object of the invention is to effect by automatic apparatus the softening of water as it is supplied to a cistern. For this purpose the water, as it issues in a stream from a ball supply cock, is caused to draw along with it a smaller stream of the solution which is being used to soften the water. The stream of mixed water and solution is received into a settling cistern at one side of the water supply cistern, in which it is allowed to settle and only to pass off into the main cistern by an overflow outlet. This settling cistern is divided into two compartments by a vertical partition—the supply enters into one compartment and passes off from the top of the other—there being a small opening at the bottom of the vertical partition to allow water to pass from one compartment to the other.

MINER'S SAFETY LAMP.—Mr. A. Schanschieff, of Gipsy Hill, London, S.E., has patented a miner's safety lamp. The battery is a single fluid battery, and consists of a cylindrical vessel closed at the top by a cover which carries the plates. When it is desired to divide the battery into more than one cell, this is done by radial partitions, and the plates are arranged so as to enter the radial cells. By this means a sufficient surface can be obtained for an electric lamp without the plates occupying much of the length of the cylindrical vessel, so that the latter can have a considerable quantity of fluid put in before reaching the bottom of the plates. The vessel is only partly filled with fluid, so that when standing up one way the plates are out of the liquid, and the battery out of action. It is put into action by simply reversing the position. In order that no possible sparking should cause an explosion, all the contacts are arranged inside the closed battery cell.

MANUFACTURE OF ALUMINIUM ALLOYS.—A process for the manufacture of alloys of aluminium with other metals has been patented by A. Mann, 3, Melrose Villas, Twickenham. The invention consists in obtaining a chloride of aluminium by mixing the sulphate of alumina with any metallic chloride which will undergo double decomposition when mixed with such sulphate, and subjecting such mixture to a regulated heat in a suitable furnace, whereby an interchange of elements is brought about, so that if a mixture of sulphate of aluminium and chloride of sodium be used, a chloride of aluminium with a sulphate of sodium will be produced. The chloride of aluminium so obtained is afterwards mixed with any re-agent having a stronger affinity for chlorine than aluminium, and the powder so produced is mixed with pieces of any metal, such as copper, and melted in ordinary crucibles or in a reverberatory furnace, whereupon the required alloy with aluminium is obtained.

TECHNICAL EDUCATION NOTES.

TECHNICAL SCHOOLS IN RUSSIA.—In compliance with the special command of the Czar, M. Deljanoff, the Minister of Public Instruction, presented to the Council of the Empire, on the 5th inst., a bill for the establishment of technical schools throughout the country.

EXHIBITION OF WORKS IN WOOD.—It is announced that an exhibition of works in wood will be held in May and June next in the Carpenters' Hall, London-wall, under the auspices of the Carpenters' and Joiners' Companies. Medals and prizes in money will be offered for models, drawings, and specimens in wood connected with the trades of carpenters and joiners. Particulars as to the various descriptions and classes and the amount of money prizes can be obtained at Carpenters' Hall.

SHOREDITCH.—A deputation was introduced by Mr. Stuart, M.P. and Mr. Cremer, M.P., to Mr. Anstie, Q.C., at the offices of the Charity Commission on the 7th inst., their object being to seek a grant from funds at the disposal of the Charity Commissioners in aid of the establishment of a school for technical education in Shoreditch. It was represented that the small cabinet-making industry of the locality offered a peculiarly suitable field for technical education. Mr. Anstie expressed a hope that something in the direction indicated might ultimately be established.

NATIONAL ASSOCIATION FOR THE PROMOTION OF TECHNICAL EDUCATION.—On the 10th instant a deputation, consisting of the Executive Committee of this Association and a number of gentlemen interested in technical education, waited on Viscount Cranbrook at the Education Department. After Lord Hartington and several others had spoken, Lord Cranbrook, in reply, said that he felt the question had assumed a prominence which made it necessary that it should be carefully considered by the Government. Before the Government could do anything they must be well informed as to the circumstances of the colleges, the fees, and the nature of the instruction that was given. He reminded the deputation that the Science and Art Department spent annually £400,000 in the encouragement of science and art, and that without the purse of the Chancellor of the Exchequer he was absolutely powerless. The great work of technical education must, however, be fostered as far as possible, and he would be very happy to submit to the Government in a sympathetic spirit the case which had been laid before him.

ANNOUNCEMENTS.

NATURAL SCIENCE SCHOLARSHIP AT OXFORD.—An examination will be held on Tuesday, June 26th, 1888, and the following days, for the purpose of electing to one Open Natural Science Scholarship, worth £80 per annum, at Corpus Christi College. The examination will be held in common with Merton College, and will begin on Tuesday, June 26th, at 10 a.m. See SCIENTIFIC NEWS, vol. ii., 191.

ROYAL METEOROLOGICAL SOCIETY.—The ninth annual exhibition of Instruments, which will be held at the Institution of Civil Engineers, 25, Great George Street, Westminster, in conjunction with the Society's meeting, on Wednesday, the 21st instant, will be a very interesting and instructive one. The exhibition is to be devoted to apparatus connected with atmospheric electricity, including lightning conductors, photographs of lightning, and damaged objects, etc. A most valuable collection of some fifty photographs of flashes of lightning from all parts of the world will be shown, as well as some curious and interesting effects of damage by lightning, including the clothes of a man torn off his body by lightning, etc. The exhibition will remain open till Friday, the 23rd instant. Persons not Fellows wishing to visit the exhibition can obtain tickets on application to Mr. W. Marriott, Royal Meteorological Society, 30, Great George Street, S.W.

UNIVERSITY COLLEGE, LONDON.—The annual general meeting of University College was held at the college of

the 7th inst., Mr. J. Eric Erichsen, F.R.S., president, in the chair. In moving the adoption of the report, the chairman alluded to the proposed Albert University of London, and said it should be fully understood that University College was not in any way animated by hostility to the existing University of London; that the object of the college was to provide that residents in London who have sought instruction within their walls might not have to apply to an entirely distinct institution for their degrees. The following were admitted life governors of the college:—Sir F. Leighton, P.R.A., Professor E. S. Beesly, Professor H. S. Foxwell, Professor D. Oliver, F.R.S., Sir. J. N. Douglas, F.R.S., Mr. W. H. Perkin, Ph.D., F.R.S., Mr. H. H. S. Cunynghame, Mr. L. H. Courtney, M.P., and Mr. E. Maunde Thompson, LL.D. The following were elected fellows of the college:—Mr. Walter Asburner, B.A., Miss Louisa Macdonald, M.A., Miss Alice L. S. Riding, M.A., Mr. J. J. Powell, M.D., Mr. S. Rideal, D.Sc., Mr. R. D. Roberts, D.Sc., and Mr. P. D. Turner, M.D.

GEOLOGICAL SOCIETY.—At the annual general meeting, held on the 17th ult., the following were duly elected the council and officers for the ensuing year:—*President:* W. T. Blanford, LL.D., F.R.S. *Vice-Presidents:* John Evans, D.C.L., LL.D., F.R.S.; Prof. T. M'Kenny Hughes, M.A.; Prof. J. Prestwich, M.A., F.R.S.; Henry Woodward, LL.D., F.R.S. *Secretaries:* W. H. Hudleston, Esq., M.A., F.R.S.; J. E. Marr, Esq., M.A. *Foreign Secretary:* Sir Warington W. Smyth, M.A., F.R.S. *Treasurer:* Prof. T. Wiltshire, M.A., F.L.S. *Council:* W. T. Blanford, LL.D., F.R.S.; John Evans, D.C.L., LL.D., F.R.S.; L. Fletcher, Esq., M.A.; A. Geikie, LL.D., F.R.S.; Henry Hicks, M.D., F.R.S.; Rev. Edwin Hill, M.A.; W. H. Hudleston, Esq., M.A., F.R.S.; J. W. Hulke, Esq., F.R.S.; Prof. T. M'Kenny Hughes, M.A.; Prof. T. Rupert Jones, F.R.S.; Prof. J. W. Judd, F.R.S.; R. Lydekker, Esq., B.A.; Lieut.-Col. C. A. McMahon; J. E. Marr, Esq., M.A.; E. T. Newton, Esq.; Prof. J. Prestwich, M.A., F.R.S.; Prof. H. G. Seeley, F.R.S.; Sir Warington W. Smyth, M.A., F.R.S.; W. Topley, Esq.; Rev. G. F. Whidborne, M.A.; Prof. T. Wiltshire, M.A., F.L.S.; Rev. H. H. Winwood, M.A.; Henry Woodward, LL.D., F.R.S.

DIARY FOR NEXT WEEK.

Monday, March 19.—Society of Arts, Cantor Lecture—*Alloys;* Professor Chandler Roberts-Austen.
Aristotelian Society, at 8 p.m.—*Attention;* Mr. G. F. Stout.
Society of Chemical Industry, at 8 p.m.—*The Polariscope, and its application to Brewing;* Mr. J. Heron.

Tuesday, March 20.—Royal Institution, at 3 p.m.—*Before and After Darwin;* Professor G. T. Romanes.
Society of Arts, Applied Art Section, at 8 p.m.—*What Style of Architecture should we Follow?* Mr. William Simpson.

Wednesday, Mar. 21.—Society of Arts, at 8 p.m.—*The Evils of Canal Irrigation in India, and their Prevention;* Mr. T. H. Thornton.
Royal Dublin Society, at 4 p.m.—*An Electric Light Installation.* (I.) *How the Electricity is produced;* Rev. G. Molloy.
Royal United Service Institution, at 3 p.m.—*Land and Water Transport in the Soudan and on the Nile;* Major E. A. de Cosson.
Royal Meteorological Society, at 7 p.m.—*Atmospheric Electricity;* Dr. W. Marcet, *The Non-existence of Thunderbolts; elucidated by Accounts of Searches after them, and the Exhibition of Specimens;* Mr. G. J. Symons.

Thursday, March 22.—Royal Institution, at 3 p.m.—*Microscopical Work of the least and simplest Forms of Life;* Rev. W. H. Dallinger.
Camera Club, at 8 p.m.—*Reduction of Negatives;* Mr. Lyonel Clark.
Society of Telegraph Engineers and Electricians, at 8 p.m.—*Electrical Stress;* Professor A. W. Rusher and Mr. C. V. Boys.

Friday, March 23.—Royal Institution, at 9 p.m.; Sir F. Bramwell.—*A Lecture with—and without—Point.*
Camera Club, at 8 p.m.—*Intensification;* Mr. Lyonel Clark.
Institution of Civil Engineers, Students' Meeting at 7.30 p.m.—*Principal Types of American Swing Bridges;* Mr. H. W. Hodge.
Royal Dublin Society, at 4 p.m.—*An Electric Light Installation—How the Electricity is Converted into Light;* Rev. G. Molloy.

Saturday, March 24.—Royal Institution, at 3 p.m.—*The Modern Drama;* Mr. W. Archer.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

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EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
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Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

NOTICES.

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Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

CORAL REEFS AND ISLANDS.—As is well known, Mr. Murray has lately been made to point a moral, if not to adorn a tale, and his champion the Duke of Argyll went so far as to say that scientific men would not give him a fair hearing. This, of course, was a mistake, but whatever may have occurred before, he has now had an opportunity of lecturing in his own way at the Royal Institution, and we may be permitted to suggest that a mountain of wrath and prejudice has been made out of a molehill of scientific speculation. Formerly it was believed that coral reefs were raised from great depths to the surface by the activity of the coral animals. Darwin, however, showed that the production of ring-shaped reefs or atolls is due to the gradual subsidence of the foundations on which they rest.

Mr. Murray, on the other hand, contends that there has been no such subsidence, and that the crater-like form in the centre of the atolls is due to the carbonate of lime, of which corals are so largely composed, having been dissolved away by water, while at the same time the coral growth on the inside has been slower, owing to there being an insufficient supply of food. The greatest authority on the subject, Professor Dana, is opposed to this view, but possibly it may eventually be found that Darwin and Murray are both correct. In some cases Darwin's theory may obtain, as there is good reason to suppose; in other cases the removal of the coral deposits by solution may be the true explanation.

There was a great display of projections on the screen, and perhaps the most interesting was that of a coral reef usually covered with water, but which was photographed instantaneously by Mr. Ralph Abercromby, during the receding of a wave. Referring to the depth at which coral animals can live, the lecturer pointed out that it varies with the depth at which there is warm water, one chief reason being that the coral animals feed on pelagic organisms which thrive best in streams of warm water. He also mentioned that with regard to the solution of the carbonate of lime, the lagoon water usually contains a high percentage of carbonic acid which is constantly being produced by the decomposition of organic substances. The presence of carbonic acid in the water being necessary to dissolve the carbonate of lime, the condition of the lagoon water is therefore, in this respect, favourable to the solution, especially as its temperature is usually high.

PHOTOGRAPHY.—The remarkable display of photographs and apparatus at the Crystal Palace Exhibition, and the recent conference of photographists held in the Society of Arts' rooms, cannot fail to have impressed visitors with the great progress made in this useful art. The character of the papers read at this meeting also shows that the advances made have been chiefly due to the scientific spirit with which the *technique* of the various branches of the subject has been treated. The mere empirical use of certain solutions, for instance, with the most skilled manipulation, will lead to very little improvement; but if the operator understands the chemical reactions which occur under the influence of light, he is at once in a position to consider improved methods of attaining the end in view. The same may be said of other branches of the art, and it points to the great importance of the underlying principles being mastered by all who wish to take an intelligent part in its development. These amateurs and *dilettante* workers are more or less scoffed

at in all professions, but in photography we cannot help feeling that they have not only helped materially in stimulating makers to produce the best possible apparatus, but in many instances the results they have attained and the skilful researches they have made have been of direct advantage to the profession generally.

SCIENTIFIC TABLE TALK.

By W. Matthieu Williams, F.R.A.S., F.C.S.

Dr. Günther's account of the phosphorescent organs of some of the deep-sea fishes, taken during the cruise of *The Challenger*, is very curious. The *Inops murrayi* has neither eyes nor optic nerve, and if it had, could not use them, as the depths of its habitat are so great that no light can reach it. But in lieu of eyes that receive light it carries a lantern which gives it out. "A pair of symmetrical luminous organs are to be found on either side of the median line of the upper flattened surface of its head, the upper wall of the skull where it covers them being completely transparent."

This dark dungeon of the dreadful deep, three miles down below the light of heaven, where creatures live beyond the reach of its faintest glimmer, under a pressure of eight hundred thousand pounds on every square foot of their surface, is a world of weird mystery more grim and gruesome than the Inferno of Dante, or any atrabiliary creation of oriental romance; but still it is reality, and even down lower than the depths I have indicated there are living fish-like monsters. No less than twenty-three species have been actually caught and hauled up to the outer world from depths between 2,000 and 2,900 fathoms.

They are all blind, and carry lanterns—are all more or less phosphorescent, some of their luminous organs are backed with concave reflectors that project the light with special efficiency. "The blind leading the blind" is far less absurd than the blind lighting the blind; the leader may know the way, but how can the light-bearer show it? Shall I with Malvolio say to these abysmal beasts, "My masters, are you mad?" Or is there really some method in their proceeding? Doubtless there is, and perhaps it may be this: That as we see by receiving light, they see by emitting it. We become conscious of the existence of distant objects by means of the light that is radiated from them towards ourselves. May it be that these odd fishes attain a similar perception by means of the light that is radiated *from* themselves towards the distant things? Can they feel the outward incidence and echo of their own emitted light as we feel its incoming? These are queer questions, but they deal with dark mysteries. But strictly speaking they are no more mysterious than the common doings of our own eyes. We know nothing of the action which converts the supposed vibrations of outside matter into living knowledge.

An experiment has lately been made by Zenger which is somewhat suggestive in connection with the above. Observing that after sunset Mont Blanc exhibited a sort of bluish phosphorescence which continued until half-past ten, he projected by means of a camera an image of this upon a plate covered with a film of Balmain's luminous paint. From this he obtained a photographic picture by holding it in the dark in contact with a dry photographic plate. Other experiments were made at Prague, where fair photographs of buildings surrounding the observatory were obtained at night-time in like manner.

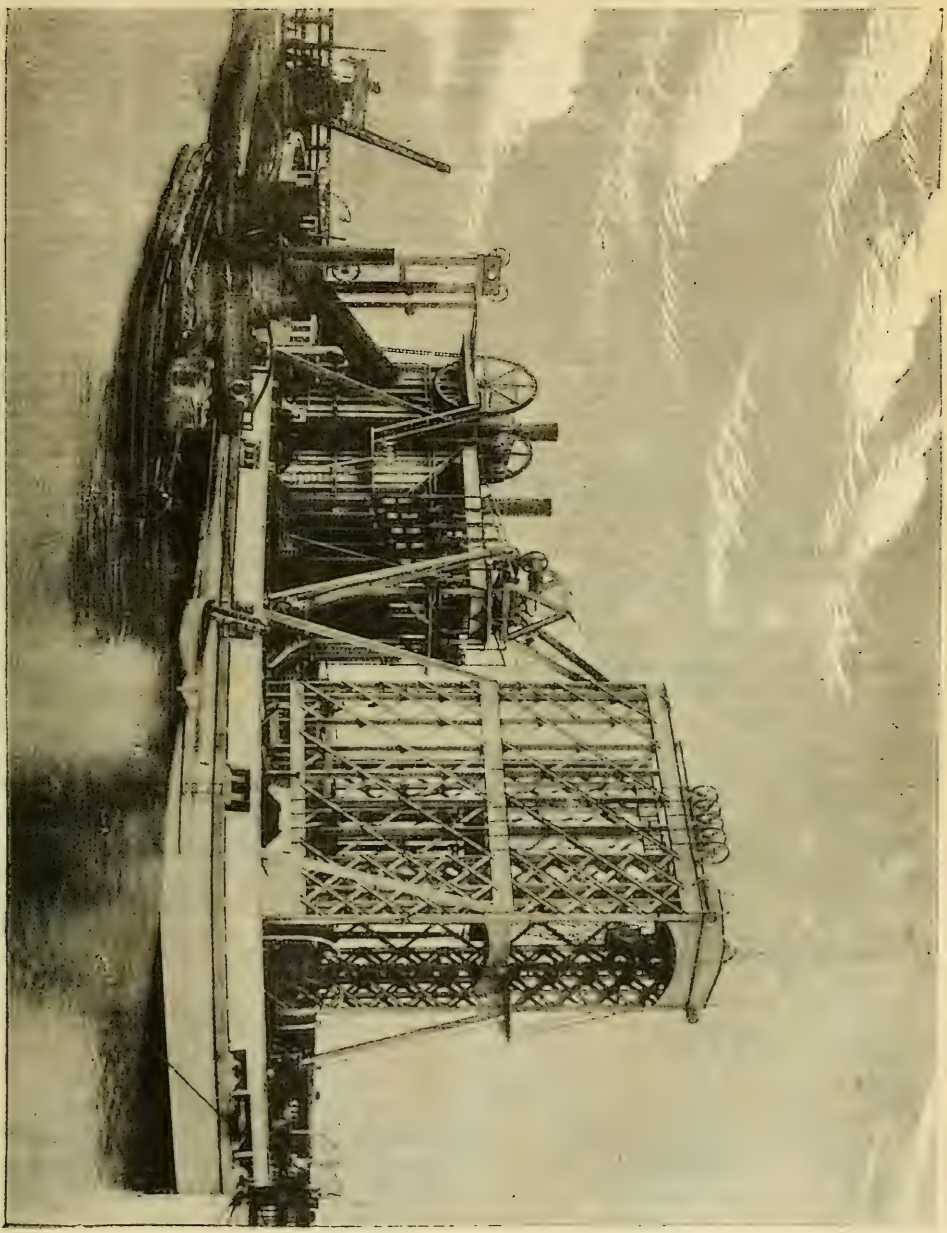
In these experiments one surface, the Balmain paint, was proved to be sensitive to radiations barely perceptible to human eyes, and another, the photographic plate, to a picture quite invisible to us, viz., the impression on the paint. Can it be that the gelatinous skin of the deep-sea fishes or some part of its gelatinous surface has the sensitive properties of the prepared gelatine plate? If so, they may see without eyes objects to which we with our open eyes are blind! A dog lives in a world of which we know nothing. He can travel over a strange road in the dark and find his way back by virtue of a panorama of odours presented to his mind through his nose and there stored up in memory. So may these eyeless phosphorescent fishes enjoy the scenery and know the objects of their world so horribly dark to us by means of self-lighting skin vision.

The very serious question of whether or not scarlet fever is sometimes communicated by milk has now been very positively answered in the affirmative, and with practical unanimity, by the highest authorities. The evidence upon which this decided reply is based has opened another serious question, viz., whether this terrible disease, which so largely attacks the juvenile milk-drinking population, is primarily a cattle disease, one that was originally communicated to human beings by the milk of cows suffering from a peculiar affection of the mucous membranes resembling the first throat symptoms of human scarlet fever, though not followed by the "rash," which, even if it did exist, could scarcely be visible on the hair-covered hide of a cow.

Some eminent pathologists have gone still further. They are now discussing, or, better than discussing, are investigating, the supposed bovine origin of pulmonary tuberculosis—consumption. An array of eminent names are associated with this research; Kock, Clyne, Walley, McFayden, and Sims Woodhead may be named, but I must not attempt to describe the work or the conclusions of each, beyond stating that it includes microscopic examination of the bacillus of human tuberculosis and comparison with the bacilli of bovine tuberculosis and experimental inoculation of each on other animals in order to compare symptoms.

That milk may be a free carrier of disease, even of slight bodily disturbance, is proved by the experience of every mother that her infant is affected when the mother partakes of such trifles as cabbage, or the first rhubarb tart of the season. Knowing this, knowing the scarlet fever liability, and being questionably threatened by other serious dangers, we are all bound by the dictates of common prudence to take precautions. Fortunately a very simple, easy, and effectual precaution is readily available. The pestilential microbia are killed when exposed to the temperature of boiling water, and the boiling point of milk is higher than that of water. Therefore the boiling of all the milk that enters every household should be sternly enforced. A wise and beneficent despot would prohibit the sale of raw milk to any of his subjects, but free-born Englishmen would rather be poisoned than submit to such interference with the liberty of the subject.

It should be noted that condensed milk is already boiled, and I may add that the scum which rises to the surface of fresh milk during boiling is highly nutritious, wholesome food, and therefore should not be wasted. It is the albumen of the milk which the heat coagulates.



ROCK-EXCAVATOR FOR THE SUEZ CANAL. (*For description see next page.*)

ROCK EXCAVATOR.

HITHERTO it has been usual to bore and then to blast rock when it interferes with the carrying out of engineering works, such as harbours and canals, and this is effected with great difficulty and expense when the rock to be removed is under water. Our illustration on the preceding page represents a new kind of rock-cutting dredger, which has been built by Messrs. Lobnitz and Co., of Renfrew, for deepening and widening the Suez Canal, at one part of which about three million tons of hard limestone are to be removed. In this system there is no boring, and no blasting, the rock being broken up by a succession of blows given to it by heavy vertical chisel-pointed rams. In the *Dérocheuse* there are ten of these rams, each 42 feet long, and each weighing four tons. These rams can be seen through the framing in the forward part of the dredger, there being five rams on each side of the well through which the dredging buckets lift the *débris*. The rams are raised by hydraulic power to a height of ten to twenty feet above the rock; they are then allowed to drop, and as they can deliver about 500 blows in an hour, it is easy to imagine that the surface of the rock must necessarily be shattered.

The work done by this machine is very rapid, as was proved in a careful trial made in December last in the Western Tidal Harbour of the James Watt Dock, Greenock. The rock bottom at this place is of peculiar formation, very hard and difficult to operate on; but notwithstanding this the amount of solid rock cut and lifted averaged over forty tons in a working hour. Our illustration represents a general view of the *Dérocheuse* as seen at work during this trial.

This system has the further advantage of enabling rock to be removed close to dock walls, without endangering their stability, whereas with blasting this is attended with considerable risk.

The same principle can be applied to the removal of rock on dry land, and extensive trials were made with a single ram at Craigmillar Quarry, Edinburgh, where the rock is one of the hardest in Scotland. The ram weighed two tons, and was raised by a steam winch; the fall of the ram was about eighteen feet, and an average of over four cubic feet of rock was dislodged at each blow. With a heavier ram the yield of broken rock would be still greater, but the results actually obtained are sufficiently good to warrant us in speaking well of the system, and they must be very encouraging to the makers of the machine.

EARTHQUAKES AS AGENTS IN THE FORMATION OF NATIONAL CHARACTER.

PROFESSOR MILNE, of Japan, well known as a diligent inquirer into the causes, the phenomena, and the results of earthquakes, has recently put forward in the *Transactions of the Japanese Siesmological Society* some striking speculations on the possible moral and emotional results of these catastrophes. He contends that the human mind never grows accustomed to even the smallest earthquakes, but that a constantly-increasing terror is produced. The effects of the more violent convulsions, he argues, are disastrous no less morally than physically. The survivors of the great Manila earthquake in July, 1880, declared themselves demoralised. They declared:—"We have lived ten years in a minute"; and the general effect of such earthquakes as that of Caracas in 1812—when "from the first tolling of a bell to the falling of the last stone of the city of Caracas one minute only elapsed"—of Chio in 1881, and many others, is that "whole communities suddenly suffer a mental paralysis which in many cases amounts to madness," and "for years after such a catastrophe every tremble in the earth will produce a panic. The experience and fears of fathers are handed down to their children, and before these terrors have become things of the past a fresh disaster adds fuel to the fire consuming the moral constitution." In former times earthquakes were, like cyclones, regarded as Divine judgments for the sins of men. In 1608 the Kirk Session of Aberdeen accepted a shock as "a document that God is angry against this land, and against this city in particular." On further consideration it was decided that the special sin of the people of Aberdeen was salmon-fishing on Sunday, and a certain learned Fellow of the Royal Society argued in the *Philosophical Transactions* that earthquakes must be Divine judgments on men, seeing that they visit great cities and not bare cliffs and uninhabited beaches, forgetting that on uninhabited beaches the phenomena produced are unobserved and unrecorded. In Lisbon in 1756 during the earthquake the populace seized a young Englishman and baptised him against his will to appease the wrath of an offended deity.

Professor Milne concludes that the effect of seismic phenomena on the human race has been very great. In some cases they have distorted the powers of reason and have begotten superstition, the imagination has been stimulated, and among the weaker members of the community, by the creation of feelings of timidity, resulting perhaps in mental aberrations like madness or imbecility, the seeds have been sown for a process of selection, by which the weaker members in the ordinary course of racial competition must succumb. The survivors, living in insecurity, perhaps grow reckless and careless, and thus the whole life of a nation may be affected. The successful nations of to-day are not those which have had to fight against these unintelligible terrors of nature. In such places as Japan and Naples we find light-hearted carelessness and disregard for the morrow more prevalent than elsewhere, and in all earthquake countries the arts conducive to pleasure are highly cultivated. If, says Professor Milne, the seismic force of South America were turned loose in England or Germany, it would ultimately produce a people with no idea of permanency, among whom everything spiritual would collapse, and might result in sinking Germans and Englishmen to the lowest level in the ranks of civilised communities. "From one section of the people we might hear a wail of misery and repentance, and from another the shouts of ribaldry and licentious mirth."

Now, whilst we admit that earthquakes have a demoralising effect upon a population, we cannot but conclude that Professor Milne has overstated his case, or that a wider induction would have led him to a serious modification of his conclusions. Living, as he does, in Japan, he must know that in no independent region of Asia is such progress being made in education, in art, and industry as in that home of earthquakes. Surely their schools, their colleges, their scientific journals, their students dispatched to Europe to learn everything, whether of a practical or a theoretical character, are certainly not features of "recklessness or carelessness," nor of a "disregard for the morrow."

Or suppose we turn to South America. We see there a region extending all along the western and north-western coasts haunted by earthquakes, to an extent not surpassed in any region of the globe. This region comprises Chili, Bolivia, Peru, Ecuador, New Granada and Venezuela. Further in all these countries the Spanish race is dominant. Yet we find here a very marked difference. Bolivia, Peru, Ecuador, New Granada and Venezuela certainly exhibit the spectacle of anarchy and revolution. Their resources remain undeveloped. Their mental condition is ignorance and superstition. But Chili, no less subject to earthquakes, has a settled government, and is making marked advances in commerce, in industry, and in education.

It must here be remarked that the folly of the early Spanish settlers in South America has greatly aggravated the injury to life and property, and of necessity the emotional derangement due to earthquakes. They erected huge, massive palaces, government offices, and especially cathedrals, which, in case of a shock, collapsed in heaps and crushed the inhabitants by hundreds. The mischief was enhanced by the superstitious habits of the Spaniards and Portuguese, on the first symptoms of an earthquake to flee to the churches and prostrate themselves around the altars, thus offering themselves to be crushed.

Had they made their abodes of light materials, and had they fled, not to the churches and convents and to the sea shore but to elevated grounds inland, the deaths would have been few and the panic trifling.

But it may be said that the ancient Peruvian empire, which had seen its best days before the desolating inroad of Pizarro, had its massive and splendid buildings.

Architectural remains are, for instance, to be seen on the banks of Lake Titicaca, which rival the grandest structures of ancient Egypt and India. This is perfectly true, but the Peruvians knew *where* to build. They had found, by the observation of ages, that whilst certain localities are frequently and heavily shaken, other spots, immediately contiguous, remain undisturbed. But the haughty and bigoted Spaniards despised the knowledge and the traditions of the natives as savage and heathenish, and destroyed all accessible records.

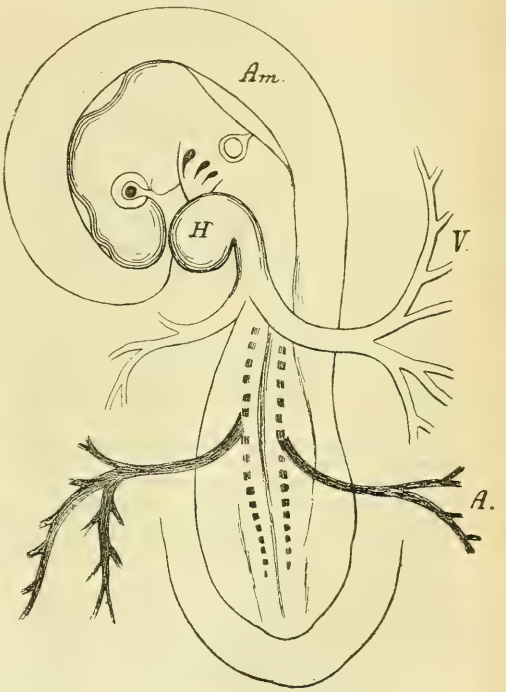
For this piece of "Vandalism"—though we may question if the Vandals were ever so foolish—he and his descendants have paid, and are still paying, at a very dear rate.

But we have not yet done with South America. On the opposite side of the Continent to Chili lies the territory of La Plata, now more generally called the Argentine Republic. In climate and in the origin of its people it much resembles Chili, but it has been very rarely, and in comparison, very slightly visited by earthquakes. Now, if we examine Chili and the Argentine Republic we do not find any marked moral or emotional superiority in the people of the latter as compared with those of the former. Buenos Ayres is as light-hearted, pleasure-seeking as Valparaiso or Concepcion.

If we turn to Europe we find that the Greek islands and Southern Italy, though never free from earthquakes, must rank among the earliest seats of a progressive civilisation. The same part of Italy was marked by the earliest dawn of modern scientific life as we find shown in detail in the biography of Giadano Bruno, by M Bartholmez. If in the seismic regions man will build, not with stone and lime, but with iron plates bolted together, he will have little need to fear earthquakes. Not the least important problem of practical geology will be to distinguish the safe from the dangerous areas.

A FOWL'S EGG.

THE egg of the fowl is of a very beautiful oval form, somewhat broader at one end than the other. Eggs of sea birds laid upon bare rocks often have this inequality much exaggerated, so that the egg cannot roll except in a circle, and runs little risk of being blown off the ledge by a gust of wind. The fowl's egg is white or very pale brown, the colour, if any, being deposited as a film upon the surface of the shell. The eggs of some birds are tinged with a colour secreted by the oviduct, and blotched, apparently by blood exuded from vessels. The shell is porous, and permits free access of air to the chick. To examine an egg carefully, it should be broken gently



THREE-DAY CHICK.

H, heart. Above it are three gill-slits; the eye to the left and the ear to the right. *V*, veins from yolk-sac. *A*, arteries to yolk-sac. *Am*, amnion.

beneath water. We then observe that the shell is lined by a tough membrane, composed of fine fibres felted together. At the broad end the membrane is double, and encloses an air space. Next comes the white of the egg. It can readily be seen that the white is not uniform throughout. Attached to opposite poles of the yolk-sac are two cloudy masses of rather firmer albumen, the chalazæ. These loosely connect the yolk-sac with the white of the egg, so that both tend to move together when the egg rolls. Friction upon the surface of the yolk-sac is thus avoided. The white has a spiral

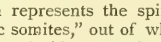
arrangement, being wound round and round the yolk-sac. It is said to be possible to unwind the white completely in a hard-boiled egg, a feat which we have failed to perform, but it is easy to prove that the spiral winding actually exists. The yolk is enclosed in a transparent spherical bag, the yolk-sac. It consists of several concentric layers, which can be demonstrated, though not easily, in a hard-boiled egg. At one point on the surface a whitish patch is seen. Here is situated the so-called "white yolk," a substance of slightly different composition and lower specific gravity than the rest of the yolk. It acts as a float, and keeps uppermost the spot where the body of the chick is to form.

The history of the egg begins long before it is laid. It leaves the ovary as a soft, round bag, containing only yolk, and then becomes invested, during its passage along the oviduct, with the successive layers of white, shell-membrane and shell. Fertilisation occurs in the upper part of the oviduct, and while the shell is forming, the yolk undergoes the singular internal change known as segmentation, the first formation of cellular tissues by division of the originally simple cell. While hatching goes on, the yolk-sac rises to the top in all positions of the egg, and therefore lies close to the body of the hen, being covered only by the shell and a scanty layer of albumen. The spot of white yolk immediately above which the body of the chick forms, occupies the highest point of the yolk-sac, no matter how the egg may be turned. At first the tiny chick lies face downwards upon the yolk, one side being turned towards the broad, the other towards the narrow end of the shell. As it gets a little bigger, its head topples over to one side. Still later it shifts, so that its body lies along the principal diameter of the egg. When hatching is ended, the chick is curled up in a very close and apparently uncomfortable position, and almost fills the whole space which was originally occupied by the yolk and white.

The sitting hen leaves the eggs to cool once or twice a day while she goes away to feed. About once a day she turns the eggs with her foot. These points have to be noticed in artificial hatching. If the eggs are not turned, a certain temporary breathing organ, the allantois, is apt to adhere to the shell, membrane, or to some part of the body, causing injury and even death. Artificial incubators should provide for free access of air, a fair amount of moisture, and a tolerably steady temperature of 41° C. (106° F.), which must not be exceeded. Hatching occupies three weeks in the case of the fowl. Fertile eggs are only to be had in sufficient numbers in spring. From the end of February to June they are plentiful enough. If the reader has a "broody" hen, or can fit up a water-bath with a regulated gas-jet or other contrivance for securing the necessary conditions to successful hatching, he may observe very easily and pleasantly the principal stages of the development of a chick, a study which has no match in point of biological interest. The eggs should be marked with the date of setting, and taken out at different times. The egg of the third day is easy to manipulate and very instructive, and it is not a bad plan to get quite familiar with it before attempting either earlier or later stages. Have ready some water of the temperature of the hand (warmed normal saline solution is better still), prick a hole in the broad end of the egg, so as to allow the escape of air from the air space. This will cause the yolk-sac to sink a little, and escape injury in opening. Then cut round the egg-shell with a stout pair of scissors, floating all the contents at once into the warm water. A simple lens will do a good deal for the investigation of the embryo, and those who have access to Malpighi's wonderful treatise on the formation of the chick, published more than 200 years ago, can see in his elaborate and accurate figures how much may be done without compound microscope or staining or microtome. For thorough study, however, the microtome is an immense help, and some technical book, such as Foster and Balfour's "Manual of Embryology," should be diligently studied.

It may give the beginner some notion what to look for if we describe briefly a three days' chick. At this stage the body lies in the middle of a circular area overspread by blood vessels. Two arteries leave the hinder end of the body, and ramify upon the yolk-sac. Here the blood takes up nutriment and a fresh supply of oxygen, returning by two veins which pass to the heart a little in front of the arteries just mentioned. The heart is a rounded speck, as yet outside the unclosed body-wall. It beats energetically, driving the blood in the first instance to the neck along the arterial trunk. This arterial trunk divides on each side into three aortic arches, which encircle the gullet, and re-unite above it to form the dorsal aortæ, from which, among others, the vessels of the yolk-sac are given off. The two dorsal aortæ are now united for a short distance. In this stage the vessels of the chick resemble in a striking degree those of a full-grown fish. The arterial trunk in each animal breaks up into several successive pairs of aortic arches, which encircle the gullet and re-unite above. In the fish, gill-slits intervene between the arches, and the arrangement is obviously adapted for securing the aëration of the blood. A stream of water entering by the mouth traverses the gullet and issues by the gill-slits, bathing the blood-vessels which lie spread out in its course. In the embryo chick we have substantially the same arrangement of vessels and gill-slits, but the stream of water upon which the immediate use of the whole apparatus depends has ceased to flow. This is plainly one of those survivals of primitive structure which so often force themselves upon the notice of the embryologist. The brain occupies the curved fore end of the chick, and its lobes are tolerably plain. The eye and ear are easily made out. At present the head is lying on its side, but the hinder part of the body retains its original position, what is afterwards to form the front of the abdomen being still open towards the yolk-sac. On each side of the recently closed tube which represents the spinal cord, is a row of "mesoblastic somites," out of which the paired muscles of the back and sides, together with some other regularly repeated parts, will shortly be developed. No sign of the limbs is to be discerned, but in the course of the fourth day these will begin to protrude. A great part of the body, especially at the head end, is enveloped by a transparent hollow sac filled with fluid. This is the amnion, a temporary structure which does not enter into the permanent body.

The figure will explain these and other details, and may be useful in guiding the first steps of some aspirant to the fascinating pursuit of embryology.



Subterranean Moss.—According to Professor Schnetzbr, a curious moss is found, growing at the depth of 200 feet, in the sub-lacustrine moraine of Yvoire. It contains grains of chlorophyll perfectly formed.

General Notes.

The Alleged Occurrence of Sugar in Corn.—According to the recent investigations of Professor von Asboth, no kind of grain contains sugar, either saccharose or glucose.

New Welding Process.—Mr. W. B. Middleton, of the Pen Iron Works, Lancaster, has discovered that if pieces of steel, at a welding heat, are covered with silicate of soda, they will weld perfectly. The method has been patented.

Action of Light upon Selenium.—The crystalline form of selenium has its electrical conductivity strongly affected by light; under favourable conditions, its resistance in bright sunlight is not more than six or seven per cent. of its magnitude when the metal is in a dark chamber.

Temperature of the Soil.—According to *Ciel et Terre*, the temperature of the soil at the depth of 14 yards was found by Dr. Stapff to vary more considerably than that of the air, sometimes, in sand, as much as 104° Fahr. These experiments were made in South Africa, and we may doubt whether their results will be found to hold good universally.

Real Strength of Wrought Iron.—Mr. F. A. Paget *(Architect)* concludes that the apparent increase of ultimate strength through successive breakages is referrable to a diminution of elasticity. The breaking strength alone does not indicate the quality, but must be taken conjointly with the elongation.

Poisonous Principle of the Hop.—The acid bitter principle of the hop, lupulinic acid, is, according to H. Dreser (*Biedermann's Central Blatt*), an energetic poison. One quarter of a milligramme kills a frog, and twenty to twenty-five milligrammes injected into the blood proves fatal to a rabbit. In warm-blooded animals the action bears upon the *medulla oblongata*, with ultimate arrest of respiration.

Intensification of the Sense of Smell in Hypnotised Subjects.—Dr. Sauraine (*Humboldt*) mentions that eight persons, four of them entire strangers, were presented to a hypnotised patient, and she was allowed to smell the hand of each. The handkerchiefs of the whole party were then mixed together, and the patient, in spite of all precautions, succeeded in distinguishing that belonging to each person simply by the smell.

Pre-historic Remains.—The *Ganulois* describes some interesting archæological discoveries made on the plateau of Champigny by MM. Rivière, Carbonnier, and Le Rey des Closages. The specimens consist of arms and tools of flint, earthenware, stone rings, clubs and bones belonging to the neolithic epoch. All these objects have been found in the vegetable mould at a slight depth, and in excavations not more than two yards in depth, and containing also charcoal. The materials from which the objects had been made seemed to have come from a distance.

Artificial Rubies. — The rubies manufactured by MM. Fremy and Feil, identical in all points with the natural stones, are figuring very extensively in the French press. The specimens exhibited at the Academy of Sciences are not larger than a pins head, but they are beautifully crystallised and hard enough to scratch the topaz. It is not thought by competent judges that this successful experiment will affect the price of rubies, as the care and attention required in producing the artificial stones are excessive. M. Verneuil passed two days and a night watching a crucible, to guard against any undue fluctuation of temperature.

Fluorescence and Phosphorescence.—Prof. E. Wiedemann has made a new study of these phenomena. He proposes the general name *luminescence* for evolutions of light which do not depend on the temperature of the substance concerned. Fluorescence and phosphorescence he groups together as photo-luminescence, the light occasioned by electric discharges he names electro-luminescence, that appearing in chemical processes he terms chemi-luminescence; the light which appears on gently heating fluor-spar is thermo-luminescence, and that developed by friction and crystallisation is respectively tribo-luminescence and crystallo-luminescence.

Curious Geological Phenomena.—The Cordillera of the Andes has for some time been exhibiting a curious phenomenon. It results from observations made upon the altitudes of the most important points, that their height is gradually diminishing. Quito, which in 1745 was 9,596 feet above the level of the sea, was only 9,570 feet in 1803, 9,567 in 1831, and was scarcely 9,520 in 1867. The altitude of Quito has therefore diminished by 76 feet in the space of 122 years. Another peak, the Pichincha, has diminished by 218 feet during the same period, and its crater has descended 425 feet in the last 25 years. That of Antisanahas sunk 165 feet in 64 years.—*La Gazette Géographique.*

Solder for Glass, Porcelain, and Metals.—A peculiar alloy has recently come into use in France as a solder for substances which cannot bear the application of a high temperature: copper in powder, obtained by treating a solution of this metal with scrap zinc, is put in an iron mortar, lined with porcelain, and mixed with strong sulphuric acid (spec. gravity 1·850). From 20 to 36 parts of the powdered copper are taken according to the desired hardness of the solder. To the cake thus formed add 70 parts of mercury, stirring constantly. When the amalgam is formed it is washed with hot water, and let cool. For use it is heated until it takes the consistence of wax.

Carbonic Acid in Schoolrooms.—Experiments have been recently made by W. Fossek on the quantity of carbonic acid in an unventilated schoolroom before and after the meeting of the class. In three determinations made before the pupils entered, he found the air to contain respectively 0·078, 0·092, and 0·088 per cent. by volume. After three hours' occupation by the class of

fifty-eight scholars, it contained 0·620, 0·636, and 0·557 per cent., or between seven and eight times as much. Besides this there are the bodily exhalations, which are still worse than the carbonic acid. The practical lesson taught by these facts is, that wherever school accommodation is at all limited, the pupils should go out for a run between each lesson.

ELECTRIC LIGHTING AND SEWAGE DISPOSAL.—A very novel installation of the electric light has been recently carried out by Messrs. Woodhouse and Rawson at the Crossness pumping station, where the huge depositing tanks for sewage are lighted up. A great deal of difficulty was experienced in carrying out the contract, as the men had to work in long waterproof boots in the midst of the floating sewage matter; the vapour and sewer gas rotted all the bindings on the insulators, until at last wire covered with gutta-percha was used. The lamps are all enclosed in water-tight lanterns, and hang from the springs of the arches. Formerly the men working in these tanks had each to carry three or four candles about with him, affixed to the end of a stick, and these, in consequence of the bad atmosphere, burnt very badly. —*Electrical Review.*

SAFETY FROM EARTHQUAKES. — M. Zaborowski, in *La Justice*, expounds the views of M. Louis Tudor on this subject. He considers it important to select localities which have been free from shocks from time immemorial. He gives as an instance Nola, near Naples, Quito, Puembo, or Tumbaco, in New Granada, which have all escaped successive earthquakes, whilst adjacent towns or villages have been ravaged or destroyed. He mentions that all the places which have enjoyed such immunity are built on or near deep wells, mines, caverns or natural clefts in the subjacent strata. He refers also to the recognised fact that in the deep mines of Chili the earthquake shocks which agitate the surface are not noticed. M. Zaborowski thinks that deep cavities can serve only to check the propagation of the earthquake-waves, so that their efficacy depends on their relative position.

EXPLORATION IN THE ALASKA REGIONS.—The party sent by the Dominion Government to explore the country adjacent to the Alaska boundary, has returned to Victoria, having collected much geological, geographical, and general information about the country, which is far from being the Arctic region it is sometimes represented to be. The point reached by Dr. Dawson was the junction of the Lewis and Pelly rivers, about 1,000 miles north of Victoria. The flora in this locality differed little from that on the banks of the Fraser. A stretch of open grassy country exists along the streams tributary to the Yukon. No areas of tundra, or frozen swamps, such as are to be met with in the interior of Alaska, were discovered by the expedition. Dr. Dawson is of opinion that the whole country, from Cassier to the vicinity of Forty-one Mile Creek, on the Yukon river—which is near the eastern boundary of Alaska—will yield more or less gold in placer deposits. This would constitute a gold-bearing region fully 500 miles in length, and of indefinite width.

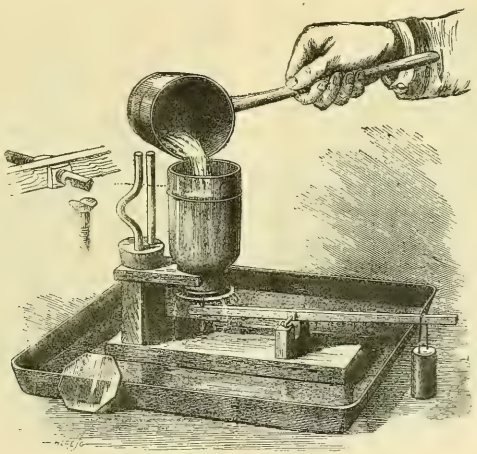
THE PERSPIRATION.—According to the *Lancet* the result of elaborate research made by M. Peiper yields the following conclusions:—The perspiration is more concentrated on the right side of the body. This observation is in accordance with that of Reinhardt; it would be interesting to know whether the opposite was the case in the left-handed. The palm of the hand sweats four times more than the skin of the chest, and the cheeks one and a half times as much. There is a slow increase in the sweat in the afternoon, especially obvious from eight to twelve o'clock at night. After midnight there is a diminution. Feeding has but little influence on this function. Elevation of the surrounding temperature increases the perspiration, and variations of the hygrometric state of the atmosphere have an immense influence on the function. The quantity of water evaporated in a quarter of an hour from a cutaneous surface 25 centimetres square, in a normal individual, is about ·176 of a gramme. In infants the quantity is generally less than in adults. The weight of the body and sex have no marked influence on the perspiration.

LIGNITE.—Although briquettes are rapidly gaining favour in Germany, especially as fuel for industrial purposes, the use of lignite is, according to *Industries*, also extending. The Berlin Coal Company have for some time past been raising lignite from a mine in the province of Brandenburg, near the Teupitz Lake, and are now about to extend their operations. They have just acquired mining rights over about 10,000 acres of land, and in addition to the first shaft, which was sunk some time ago, another shaft is about to be commenced. In connection with this work some important orders for pumping engines and mining appliances generally will be given out. The coal is of an excellent quality, very dense, hard, and is obtained in large pieces. A good market is secured for it at the start by the neighbouring brick works of Morzen, where there are thirty-two Hoffmann kilns, requiring annually about 300,000 tons of coal. The district has exceptional transport facilities, there being two waterways from the lake to Berlin, in addition to various railway lines. Owing to this competition, freights to Berlin rule as low as 1s. per ton; that is, about the same charge as is made by the railway companies for delivery within the town.

ENGRAVING WITH MERCURY AND ITS SALTS.—According to the *Memorial Industrielle*, if a well-polished and clean plate of zinc be taken, and a design traced thereon with mercury, the design will appear in brilliant white upon the grey background of the zinc. An intaglio plate can be obtained by plunging the plate into a bath containing 100 parts of water and two parts at least of nitric acid. The action of the acid is very rapid, and for a long time only attacks the parts touched by the mercury. When deep enough it can be used for lithographic work. If, instead of nitric, hydrochloric acid is used, the contrary effect takes place. The unaffected zinc is strongly attacked, and the traces of the mercury give a relief plate, which can be used for ordinary typographical work. If the operator does not wish to draw upon zinc, the design can be traced upon paper with biniodide of mercury. The sheet of paper being then applied for two hours to a plate of zinc, the drawing is sharply reproduced in white lines of amalgam on the grey surface of the metal, just as if it had been traced directly. The same result is obtained if the design be traced upon paper with a sticky substance (ink containing gum or sugar), and if it be dusted over with a mercury salt in fine powder. On dusting off the surplus and applying the sheet containing the design to a plate of metal, the same result is obtained.

PASCAL'S VASE.

THE law of the pressure produced by a column of water is very perfectly illustrated by the apparatus known as Pascal's vase. In the illustration is shown a method of constructing it that is far better adapted to the purposes than the usual one. Several experiments or modifications of experiments can be carried out with it that the regular apparatus does not admit of. As shown, it is very simply made, and its construction will be within the capacity of anyone of moderate mechanical ability. For the vase a wide-mouthed bottle is selected. This should have as true a neck as possible, as regards its lower face. The bottom is first cut off. This may be executed in various ways, the most reliable, perhaps, being the time-honoured method—with a hot poker. The neck has now to be ground. Some sand is placed upon a glass plate resting on a table, and is well moistened with turpentine. The bottle is held on this, neck downward, and rubbed with a circular motion till a flat surface



is produced, care being taken to hold it steady, so as not to rock it. The surface thus obtained may be smoothed off with ground pumice, used like the sand. The sharp edge, where the bottom was cut off, may be removed by similar grinding, or by a few strokes of a file. If the grinding is well done the bottle, when placed with its open neck downwards, and resting upon a piece of glass, can be filled with water, which it will hold with scarcely any leakage.

A wooden frame is next made to hold the bottle. A semi-circular opening grasps it tightly near the shoulder, holding it a couple of inches above the base. If it rocks or moves a band of paper can be used as packing to secure it. To close its neck, a plate of perfectly flat glass is cut a little larger than the outside diameter of the neck. The plate may be square, octagon, or circular. The latter is the best shape.

A support for a balance beam is mortised or screwed fast to the base. A slot is cut in its axis, within which the balance-beam can play. For fulcra, or bearings, for the knife-edges, two wood screws are driven into the top on each side of the slot, and shallow, open grooves are filed in them. The beam works upon knife-edges, which are thus constructed. An iron bolt, about three-sixteenths of an inch in diameter, is selected, one which has a long thread being best. Two nuts are required. One is screwed up as far as it will go. A hole is made through the balance beam, and the bolt is thrust through it until the nut comes against the beam. Then the other nut is screwed up so as to hold the beam in place. The projecting portions of the bolt are filed off to a straight and true knife-edge, and the head of the bolt is cut off. If the threaded portion of the bolt should be too short to admit this treatment, one nut may be reamed out and passed beyond the thread upon the cylindrical portion of the bolt. There it must be secured by soldering. This forms a good abutment for the beam to bear against. Care should be taken to have the bolt perpendicular to the beam. The knife-edges are quite hard enough for the limited work the balance is required for.

Upon the upper surface, and near the end of the beam, a notch is made. Into the other end, at the upper surface, an iron pin is driven as near as possible to the centre of the opening of the neck of the bottle when the beam is in its bearings. This pin is filed to a sharp point. A couple of lead weights are arranged to hang from the notched end of the beam. These are easily cast in paper. A sheet of paper is rolled round the end of a round stick of wood, such as a broom-handle, so as to project a couple of inches beyond the wood, and tied securely with string. The paper should be eight or ten layers in thickness. Into the cylindrical cavity thus formed the lead is poured when just melted, and while still fluid the suspending loops are placed in it, and held until all is solid. Two weights of different sizes should be provided.

The apparatus is arranged as shown in the cut. The weight holds the glass plate against the bottle, only the sharp point of the pin on the balance touching its under surface. Water is now poured into the vase. If the weight be not too heavy, as soon as a certain level is reached the water will begin to run out between the glass plate and the ground surface of the neck. The level of the water where this occurs is marked by springing an india-rubber band round the bottle. This illus-

trates the downward pressure of water. The flask can never be filled any deeper. Any excess of water introduced escapes until that level is reached. The flask may now be emptied, and a cork fitted with two small tube of any size and shape is inserted from above into the neck. Water is now poured into these. The object of having two tubes is to permit air to escape from the space between the cork and plate. A single tube, if of sufficient diameter, will answer. As soon as the marked level is reached the plate is again forced off its seat and water escapes. The tubes can only be filled to the same level as the large vase. Finally, the tubes are removed, the flask is half-filled, and a solid cylinder, such as an empty bottle, is immersed in the water so as to raise its level. Nothing happens until the mark is reached, when again the plate is forced off its seat and water escapes.

Thus the law is proved that the pressure exerted by a column of water on a given area varies with the height of the column of fluid producing it, and not with its volume or shape.—*Scientific American.*

THE STRUGGLE FOR LIFE IN THE SEA AND IN FRESH WATERS.

CHANGE in the animal life of the sea is more extensive and rapid than in fresh waters. A very little reflection will convince those who have some acquaintance with the history of life on the earth that this is actually so. We have only to go back as far as the chalk period to find the animal life of the sea entirely different from its present population, and in still earlier times the changes were so frequent and so complete as to give colour to the ancient doctrine, now abandoned, that all the life of the earth had been swept away at intervals by universal outbreaks of destructive energy. That doctrine is at once refuted by the many cases of freshwater animals which have survived with little change several of the supposed world-wide catastrophes. In freshwater deposits older than the chalk (Wealden and Purbeck) we find some of our familiar pond-snails and pond-mussels, while in the inconceivably remote time of the Coal Measures, and even earlier, our pond-mussel had a near representative.

This absence of rapid change in the life of freshwaters depends upon comparative exemption from competition. Races which have proved too feeble, too old-fashioned, one might say, to resist the tide of experiment and innovation in the broad seas, manage to struggle on in the contracted and scattered freshwater basins of the world. Thus it comes about that such antique forms as the Ganoid fishes survive in fresh waters, and there only. In their palmy days they could hold their own in the waters of the sea. Now they survive only in fresh waters, and there by virtue of isolation.

There is, as it were, a difference of pressure between the full tide of life in the open sea, and the sluggish persistence of animals confined to land-locked waters. This is illustrated by the many cases of marine animals which have become fluviatile. The perch is a familiar case among fishes, and Dr. Günther speaks decidedly as to the frequent occurrence of such transitions. Within human recollection a brackish water bivalve (*Dreissena*) and a marine or brackish water polyp (*Cordylophora*) have made themselves at home in our freshwater canals.

The explanation of all the facts cited is to be found in the relative extent and continuity of the two spheres. It is the difference between a wide continent and a lonely island. In the ocean, as on the continent, competition and innovation are rife; in the island or river-basin unchanged persistence is favoured by the fewness of competing forms and the rare appearance of new and destructive races. The wide sea or continent is, to borrow an illustration from human experience, the busy world of commerce, and invention, and restless thought, while the land-locked pool or oceanic island resembles a remote country village, where two hundred years have brought no conspicuous change in dwellings or food or dress. What the introduction of a railway is to the village, the breaking down of natural barriers may be to the population of the island and (more rarely) even to that of the river-basin. The hardy product of the wide and busy area encroaches upon the long-secluded population, and compels rapid changes, even if it does not bring sudden destruction.

The same difference in the physical conditions is accountable for the singular fact that metamorphosis, or development with transformation, is so common in the animals of the sea, and so rare in those of the narrower lakes and rivers. Where the struggle for existence is keen, and the water is filled with strong and cunning creatures eager to prey upon weaker rivals, vast numbers of eggs are produced to compensate for the vast destruction. They are turned out very early, and, as it were, "sent before their time, into this breathing world, scarce half made up." Accordingly, they differ conspicuously from their parents, or from the adult state of the few which gain full size. In the calmer waters of the lake and river few eggs are produced, and these are larger, better cared for, and take longer to develop; so that the form which issues often completely resembles the parent, except in size. The fluviatile frog, which will occur to some readers as an exception, is only apparently so. The tadpole actually represents the adult normal condition of its class, and the change to the leaping, land-traversing frog, belongs not to embryonic development, but to the same kind of *adult* transformation as the assumption of horns by the stag, or a beard by man.

We can thus rationally connect differences in liability to change, in invading power, and in the presence or absence of transformation. All will be found to depend upon the extent of the area inhabited, and the freedom of communication within it. It may be considered fair proof of the validity of the explanation that it applies, not only to the sea and the small freshwater basin, but equally well to the case (so unlike at first sight) of the continent and oceanic island, where the sole point of analogy is that contrast of size which we have found to be so influential.

RESTORING LINENS.—The washerwomen of Holland and Belgium, so proverbially clean, who get up their linen so beautifully white, use refined borax as a washing powder, instead of soda, in the proportion of a large handful of borax powder to about ten gallons of boiling water. They save in soap nearly one-half. All the large washing establishments adopt the same mode. For laces, cambrics, etc., an extra quantity of the powder is used, and for crinolines (required to be very stiff) a strong solution is necessary. Borax being a neutral salt, does not in the slightest degree injure the texture of the linen; its effect is to soften the hardest water. The laundries of Holland are said to turn out beautiful work.

Natural History.

WILD SILKS.

The secretion of silk is certainly one of the most curious processes which take place in the animal economy. We find it elaborated in larger or smaller quantities by the vast majority of true insects, by most of the spider-group, and even by some molluscs, or, as they are popularly called, shell-fish. It is singular that such a multitude of creatures, differing in their structure, their habits, and their diet, should all agree in producing a material substantially identical in its nature, though subserving very different purposes. Nor is it easy to see why if silk-secreting extends so far in the animal kingdom it is not met with also in other groups.

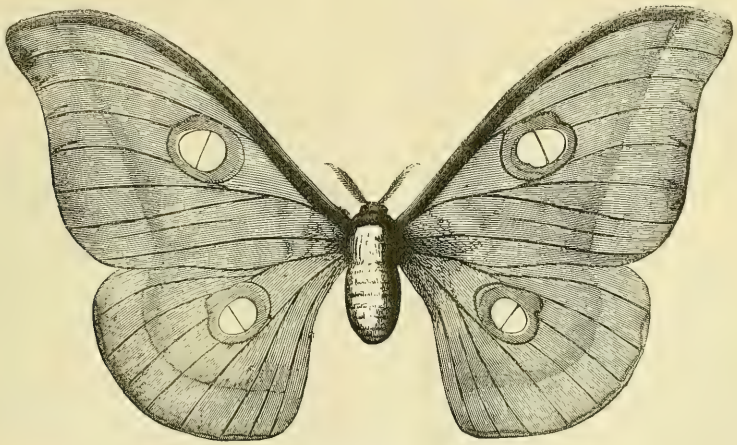
In the body of the animal silk exists as a semi-transparent gummy fluid, which, in the silk-worm and its near allies is contained in two long bags, each provided with an exit duct terminating in apertures near the mouth from which the silk can be emitted at will and attached to any substance. In its composition silk approaches to white of egg and to gelatine. But, unlike the former, it contains no sulphur. From the latter it differs by a physico-chemical property not fully explained. Every one knows that if glue or gelatine be exposed to damp air it softens; if soaked in water it swells up, and if heat be applied it dissolves. If it be allowed to stand for any length of time, especially in a damp, warm place, it becomes mouldy and is decomposed, with an exceedingly offensive smell. The behaviour of silk is quite different. When once it has issued from the body of the insect and dried, it can no longer be brought back to its original liquid state. It does not soften or swell up in moist air, and it may be pronounced incapable of putrefaction.

It is remarkable that in the group Orthoptera, the locust and grasshopper tribe, to which the most ancient insects known belong, the power of secreting silk does not exist. On the other hand, this power is at its highest stage in the Lepidoptera, which are generally regarded as the most modern group. Hence we may fairly infer that the spinning faculty has been gradually developed since the first appearance of insects upon the earth.

It further appears that, with two or three exceptions, the secretion of silk in insects is confined to their immature, or larval stage, and that this material serves chiefly for enfolding and securing the chrysalis until it reaches maturity.

In spiders we find some important differences. The organs for secreting and emitting the silk are placed in the posterior part of the body. The elaboration of silk takes place during the whole life-time, and its purpose is chiefly to serve in the capture of prey, though the females of some species enclose their eggs in a strong silken bag which they carry about.

Whenever silk is referred to in a technical or commercial point of view, we understand the product of certain moths of the genus *Bombyx*, or of certain nearly allied groups. These insects alone yield silk in such quantity as to be capable of industrial application. Spiders do not produce their thread in abundance at once so as to admit of ready collection. Nor can they be reared in numbers together on account of their quarrelsome disposition and their disposition to stray.



Antherea Mylitta.

The best known and most valued silk-insect is *Bombyx mori*, which feeds on the mulberry, and which, though a native of China, has for a long time been reared in a domestic condition in France, Italy, and other of the warmer regions of Europe. Though small, this species possesses several advantages over its larger allies. Its cocoons can be easily unwound or "reeled," so as to yield an unbroken thread. The silk is easily freed from colouring matters, and from the so-called gum, and brought to a fine, clean, white condition ready for the manufacturer and the dyer.

It is very possible that this silk-worm would have continued to supply the wants of European industry, so that the so-called wild silks, the produce of other and larger

species, would have remained almost unknown, though they have been used for thousands of years in the Far East. But a disease—or rather two diseases, known as *Flacherie* and pébrine—broke out in the silk-rearing districts of France and Lombardy, and threatened *Bombyx mori* with extinction. Hence manufacturers were compelled to seek other sources of supply, and several silk insects of India and China were thus brought into notice.

Of these, the most important is the Tussur, *Antherea mylitta*; a large moth of a leather-brown colour, having on each wing a transparent spot bordered with a violet ring. The cocoon is three or four times as large as that of the common silk-worm. Moreover, there are two crops every season, whilst of *Bombyx mori*, there is yearly only one generation. Its chief defect is a brown colour, which appears in patches. This hue is the more decided the richer the food of the insect has been in astringent matter. Tussur caterpillars, fed in Europe on the leaves of the apple-tree, gave a much darker silk than others fed on the foliage of the pear and the plum, which contain less tannin. Major Coussmaker, who has carefully studied the nurture of this species in India, finds that by a proper regulation of their diet for some time before the caterpillars spin up, the cocoons may be obtained perfectly and permanently white.

Another silk-insect, much esteemed in China, is *Attacus atlas*, the giant of the group. This insect measures upwards of ten inches in stretch of wing. The caterpillar feeds on the barberry, the sallow, the plum, and apple. The cocoon is of a light umber-brown, from two to three inches in length, and one inch in diameter in the widest part. It weighs about a quarter of an ounce.

A very interesting species is *Antherea Rama-mal*, from Japan. The silk is of a beautiful apple-green colour. The moth in question has been introduced into India, and seems likely to yield a very useful silk.

We have not space to enumerate the various other insects capable of yielding valuable fibres. We must note that although the silkworm disease has been in the main overcome, thanks to the skill of M. Pasteur, the demand for the wild silks is extending. They are used not as substitutes for ordinary silk, but for a number of novel and curious tissues. This industry owes its existence and its future prospects mainly to Mr. Thomas Wardle, of Leek, and Sir S. G. Lister, of Bradford.

Sparrow Ravages in Cheshire.—In a Manchester daily paper of the 30th ult. is the following suggestive item :—"At the annual meeting of the Cheshire Farmers' Club on Saturday evening, the chairman, Mr. John Roberts, the largest tenant farmer on the Hawarden estate, referred to the habits of the common house-sparrow, and said that the Wirral farmers of Cheshire were paying 6d. per dozen for all sparrows killed, adding that some idea of the fecundity of the pest might be formed from the fact that, without appreciably affecting their numbers in the district, no less a sum than £14 15s. 6d. had been recently spent in that way, representing the destruction of 7,192 sparrows. And this money the Cheshire farmers admit has been thrown away, as the sparrows seem to be as numerous as ever. Did these bucolic Gothamites never hear of such a phrase as the "balance of nature"? Why are th sparrows so numerous? Simply because, in the interes of game preservers, all the birds of prey have bee nearly extirpated, so that the game preservers may b able annually to slaughter a few more partridges and pheasants when the "killing times" come round. Sparrowhawks, comparatively harmless kestrels, and vermin-destroying owls are systematically shot down by the keepers; also the buzzards and harriers; and the handsome peregrine has but a short lease of life when he appears on any grouse moor or estate in the lowlands. The farmers not only complain of the loss sustained by sparrows, but about the damage done to their cereal crops, standing and garnered, by rats and mice. Could they not ask their landlords, or the keepers of the latter, to spare the raptorial birds—hawks, buzzards, owls, etc.—which prey largely on small birds, such as sparrows, and on rats and mice? If nature was allowed her own way, and if the above raptorial birds were not killed off so systematically by gun, trap, and even poison, we should not hear so much of the sparrow pest, or the destructive ravages of rats and mice. In the interests of the game preservers, stoats and weasels—the polecat is now all but extinct—which feed largely on rats and mice, are killed off, that more game may be had for "sport." — *Newcastle Daily Observer*.

All this was fully and ably enforced years ago by Charles Waterton. But he preached to deaf ears. The destruction of an owl or of its eggs should be made a misdemeanour.

Ferocity of the Alligator.—The harmless character of the alligator of North America (*Alligator Mississippiensis*) is not recognised by actual observers. A correspondent of the *Field* describes a fight which took place in Florida between an alligator and three bulls. After a desperate struggle two of the bulls and the alligator fell victims, the surviving bull being severely injured. The alligator was only 17ft. in length. We may judge what chance the three bulls would have had against the crocodiles of Borneo and New Guinea, which may reach 40ft. in length, and are more powerfully-built reptiles than the alligators of the western hemisphere. It may be useful to point out the differences between the crocodile and the alligator, as they are often confounded. The crocodile have a toothed fringe on the hind legs, and the toes are completely webbed. There is a canine tooth in the lower jaw, which is visible externally when the mouth is shut. In the alligators, on the contrary, the hind legs are simply rounded, the feet are not completely webbed, and the canine tooth of the lower jaw is received in a notch in the upper jaw, so as to be concealed when the mouth is shut. The crocodiles occupy the rivers of tropical Africa, Asia, and Australia, whilst the alligators are found in America. Some crocodiles, however, have been found in the West Indies, and one species of alligator has been met with in China.

The Excretory Organs of Spiders.—Dr. J. C. C. Loman (*Sijdsk Nederal Dierkunde Fereen*) shows that these organs are not homologous in all the Tracheata, and that possibly the Arachnidea and the Crustacea are more nearly related than is admitted in the text-books.

The Kiwi of New Zealand.—According to a correspondent of the *Newcastle Weekly Chronicle*, the egg of the kiwi, or *Apteryx*, is much larger than that of any other bird of similar size, nearly as large as that of the emu. It is to be regretted that these harmless and curious birds are being wantonly extirpated.

A Musical Butterfly.—According to Donitz (*Berliner Entomolog. Zeitschrift*), *Dionychopus niveus* possesses a peculiar vocal organ on the upper side of the hind-wings and the under side of the fore-wings when the wings overlap. Each such organ is a brush consisting of strong chitinous bristles, about one-eighth of an inch long and scarcely half that breadth. The insect produces a chirping sound by rubbing these brushes together. In spiders the vocal apparatus lies generally in the thorax, and consists of a membrane extended over a hollow space, and probably caused to vibrate by friction with the hind legs.

Deaf-Mutism in Animals.—*Le Naturaliste* mentions the case of a cow which had been purchased by a farmer when a few weeks old, and kept for twelve years. She never attended to any call, and seemed totally unconscious of any noise. If alone in the stall and feeding-time drew on she made the usual gestures of cattle when they low, but no distinct sound could be heard. Her sight was good, and nothing anomalous was observed in her ears and larynx. It would have been interesting to trace here heredity, but all her eight calves were sent too early to the butcher.

A Bifurcated Palm-Tree.—According to *La Nature*, there is growing near Cayenne a palm-tree, *Areca oleracea*, which presents in its growth a very singular anomaly. At the height of about eleven yards from the ground the trunk divides suddenly into two upright parallel stems, exactly equal in height and in diameter, and each surmounted by the usual crown of leaves. Such a mode of growth would in most kinds of trees be perfectly normal, but in the palm tribe it is a unique anomaly. As crevices are forming at the junction of the two stems it is proposed to remove this specimen to the museum of the *Jardin des Plantes*, lest it should be destroyed by a storm.

Vipers in France.—About twenty years ago the reward paid in France for the head of a viper was 5d., and 17,000 were destroyed yearly. The price is now reduced to 2½d., and the number annually killed is 10,000.

Poisoning of Mussels.—M. Bardet (*Nouv. Rem.*) concludes that the mussel is an indigestible food, which in certain persons always, and in others occasionally, occasions reflex phenomena by means of gastric irritation without the presence of any especial poison.

A Moon-Fish.—According to the *Journal de Caen*, the zoological laboratory of the Faculty of Sciences has just received a specimen of the moon-fish, *Orthogonicus mola*. This fish frequents the high seas, chiefly the North Atlantic and the entrance of the Channel. The weight of this specimen exceeds 150lbs., and measures across its disc-shaped body 44in. The body is covered with scales of a beautiful silvery white. The mouth is armed with powerful bony jaws, and the two lateral triangular fins give the fish a strange appearance.

The Lily of the Valley Poisonous.—According to *La Science en Famille* some goslings died within a couple of hours after eating a quantity of the leaves of this plant, which had been thrown away by some girls who were making floral decorations.

TECHNICAL EDUCATION.—III.

Abridgment of Paper Read at the Society of Arts by Mr. Swire Smith on the Technical Education Bill.

(*Concluded from page* 255.)

Briefly described, these secondary and technical schools would contain the necessary class-rooms and apparatus for the general instruction of youths intended for the local industries, and so arranged as to be specially available for evening classes, In connection with each school, there would be appropriate rooms for ordinary teaching, adequately furnished for science and art purposes, with exhibition room for pictures, students' drawings and art collections, a museum for technology, etc., a chemical laboratory and lecture theatre. There would also be a workshop for manual instruction, and for the illustration of the principles of science and art as taught in the class-rooms, while in some of the manufacturing towns there would be rooms specially designed for the practical application of science and art to industrial purposes.

In all technical school instruction, there should be a minimum of practice with a maximum of theory, depending largely upon the industrial facilities afforded to students in each locality. The limitation of assistance which the school may render to the workshop or factory can only be ascertained by experience, and regulated by the demands for artistic and scientific knowledge, which may be made in consequence of the increased industrial efficiency of competing nations.

Having made suggestions for the establishment, where necessary, of secondary technical schools by municipalities, and for municipal assistance to existing schools and classes, I wish to describe more fully the position and importance which I attach to technical night schools, which I believe will ultimately become the sheet anchor of the whole system of technical instruction in this country. In every department of education in the more advanced continental countries, the Technical Commissioners were almost invariably drawn to the conclusion that the buildings, methods, apparatus, and organisation of instruction were better than our own. When, however we came to the workshops and factories, and inspected the machinery, and the artisans at work, we were generally able to come to the conclusion that in energy, thoroughness and general efficiency, in other words, in the factors of production which affect quantity, we were ahead of our rivals. On the other hand, as I have previously explained, in some of the factors which affect quality and attractiveness we were behind. In a word, I am of opinion that in the ordinary occupations connected with the great industries of this country the Englishman is as much in advance of the foreigner in practice as he is behind in the theory of the lighter and more showy occupations. We have great reason for thankfulness that the main link in our industrial chain—the link of practice—is still sound and strong. But, as you know, it is the weak link which tests the strength of the chain, and here it must be admitted that in the link of theory (and in the giving to an article its showiness or selling quality), we have to take a secondary place. Our work is plainly marked out for us, and must be taken in hand without a moment's delay, and I have no doubt whatever that with day schools such as I have suggested, and properly equipped night schools, this weak link will be effectively strengthened.

The teaching of drawing, elementary science, and practice in the use of tools in elementary schools will give to all our artisan population the basis of technical instruction. The secondary technical and commercial schools will supply such theoretical training as will materially help the class of superior workmen, designers, clerks, and many employers in overcoming some of the difficulties connected with their earlier industrial experiences, besides giving them a wider general knowledge of business. In fact, the day schools, both elementary and secondary, may be compared to nurseries which prepare students, on becoming apprentices, to take up in the evening classes, often of the same schools, the special subjects of science or art connected with their daily industries. Experience has already amply demonstrated that these young men, with nothing to unlearn, can return from the workshop to their familiar class-rooms, and pursue their technical studies with enthusiasm and success altogether unknown to students who have not had the same advantages of preliminary training. There are industries of a highly artistic or scientific character which require special machinery, and for which provision must be made, but to the overwhelming proportion of apprentices the workshop during the day supplies the practice, while the evening class, taught by a practical man, in perfect touch with daily wants, supplies the theory. It is in the combination of science and art with practice which will form the best equipment for enabling our manufacturers and artisans to repel the invasion of the attractive foreign products which fill our shop windows, and therefore I believe that in these technical night schools the problem of technical education, so far as the artisan is concerned, will be successfully solved.

In no country in the world can this system be carried out so thoroughly, so profitably, and so economically, as in England. The technical schools of the Continent, although the fees are usually low and the teaching is often gratuitous, yet demand great sacrifices of time on the part of the students. Many attend at night, but after twelve hours of toil the brain is in no condition for active or enjoyable study. So the best students, frequently from eighteen to twenty-five years of age, in thousands of instances sacrifice years of practical labour and wages, in order that they may qualify by daily attendance at technical schools to become designers, foremen, chemists, or superior clerks. Having obtained this knowledge, many of them come over to England, and secure the leading situations for which their school training has qualified them, while our own young men, unprepared by scholastic training, have to fall behind into the lowlier and less lucrative positions. Those who remain at home are able to bring their superior training to bear upon foreign manufacturing industries, and thus often give employment to thousands of operatives in making tasteful commodities, whose sale in this and other countries, by depressing the value of our products, takes the bread out of the mouths of English operatives, and steals away the capital of English employers. As was stated by a foreign official, when asked the cost of the technical schools of his country, that he didn't know, and didn't trouble to inquire, for it was England and America that maintained them, by buying the beautiful manufactures and designs which the schools had enabled his people to produce.

The splendid advantage which our artisans possess over those of all others is this, that they have from six to eighteen hours per week more leisure than their rivals, whose competition is pressing us so severely.

But if leisure be not wisely used it may prove a curse and not a blessing and I regret to say that, at the present time, this advantage is absolutely wasted in hundreds of thousands of instances in this country. There are not a few experienced observers who affirm that, as a nation, we take so much more ease, and demand so much higher pay than our competitors abroad, that we must necessarily be surpassed before long in cheapness as well as in excellence of production. There are others who declare that in the lower wages and longer hours of continental operatives is to be found the secret of our industrial difficulties. To those who have faced the economic facts in the competing countries, the seriousness of such conclusions is this,—that if our wages were reduced to-morrow, and our hours of labour increased to the continental standard, and if even, in addition, our manufacturers and artisans were protected by tariff duties on imports, the nation would still go on importing many millions worth of tasteful commodities from France, and Germany, and other countries, simply because we should not know how to make these commodities ourselves. For my present purpose it is sufficient to say that I am less afraid of foreign low wages than of foreign skill, and that we can only retain our leisure by bringing higher skill to our aid in promoting the efficiency as well as the economy of our manufactured productions.

I have a great respect for the foreign designers, chemists, art workmen, correspondents, and others, whose employment in this country has already done so much to rescue some of our manufactured products and our national trade from barbarity. Like the Flemings of old, who taught us our industries, they are almost invariably good citizens, and men of superior culture. But our position would be healthier, our industrial prospects brighter, and the lives of many of our people would be happier, if these situations were filled by equally capable Englishmen. It is an insult to say that our people are inferior in natural faculties. They are deficient in taste, because in their school instruction the training in taste has not been a paying subject under the Code, as may be shown by the fact that, with all our enlightened efforts, three-fourths of the children attending our elementary schools have received no instruction in drawing; and yet this subject was properly described by Sir Henry Holland, when he presided over the Education Department, as "the mainspring of a technical education." You cannot expect art from those who have never learned to draw, any more than you can expect a literary style from those who were never taught to read and write; and so, with a South Kensington organisation which extends from John o'Groats to Land's End, only about one per thousand of our population are attending schools of art. The testimony of the most competent judges is clear upon this, that whether in art, science, or technical skill, the Englishman is not surpassed by the foreigner when his faculties have the advantage of equal cultivation.

When the Technical Commissioners visited the remarkable educational institutions of Paris, we spent most of our evenings in inspecting free evening drawing schools in all branches of technical art, of which we were told that a hundred were spread over the city supported by the municipality. We saw large placards posted on the walls, signed by the mayor, in which he appealed to all young people, as they valued their future

usefulness, to take advantage of the classes. When will the Lord Mayor of London bring himself into sympathetic touch with the great neglected masses of London, and issue such an invitation? When we visited Brussels, we made a tour of free night schools accompanied by the Mayor, the Head of the Educational Department, and the Deputy Speaker of the House of Representatives. Whoever heard of Ministers of State and the Lord Mayor of London accompanying a foreign Commission on a tour of free night schools in this great city? I suppose there are many good reasons why such a thing should not happen in the wealthiest and most populous city in the world, but I need only name one. they would not find the schools—at least of the character of the splendid free drawing schools of Brussels, because they do not exist in London, nor in any city or town in the United Kingdom.

Reviews.

Living Lights; a Popular Account of Phosphorescent Animals and Vegetables. By C. F. Holder. London: Sampson Low, Marston, Searle and Rivington.

A monograph of phosphorescence has long been wanted. It is a heavy burden if we wish to ascertain precisely all that is known concerning this interesting phenomena to search through the scores of works, memoirs, and dissertations in which the facts are buried. Hence we opened Mr. Holder's book in the anticipation of pleasure and profit.

These hopes have only been partially fulfilled. The author gives us a number of very interesting cases of phosphorescence, but he makes little attempt to explain what these instances teach. Save to a small extent in the preface, he does not enter upon the consideration of phosphorescence in general, and of its several modifications. That very decided modifications do exist may be regarded as certain. Some of the phenomena here described cannot rightly come under the heads of "living lights," since no life is concerned. The first step in the study of this very difficult and complicated subject should be to sort out from each other the different classes of phenomena here included. The luminous showers, hail-stones, snow-flakes, the light emitted on striking or grinding fluor spar, felspar, sugar, etc., cannot be explained on the principles applicable to luminous animals and plants, whether living or decaying. Leaving such phenomena on one side we find that Radziszewski has divided all phosphorescent bodies whose luminosity admitted of being tested into two classes:—1. Such as on the addition of an alkali become luminous, when they already contain active oxygen, which is formed in them under the influence of an exciting agent, such as, *e.g.*, the light of the sun. 2. Such as on the addition of alkalies form active oxygen and phosphoresce during their combination therewith. The results of Radziszewski seem, indeed, to show that active oxygen is the main agent. But there are difficulties in abundance. The emission of the light seems in some cases to be regularly intermittent, like the lamps of a revolving beacon, and in others to be suppressed at the will of the animal. Of this latter phenomenon Mr. Holder gives an instance in the breast of a heron (*Myctiardea grisea*) and of a blue crane (*Ardea coerulea*). But as the bird was observed at the distance of 150 feet, it is possible that it may, as he suggests, have occasionally altered its position, which would account for the temporary disappearance of the light. He mentions that the bird after being shot "died slowly, *the light gradually dying out and disappearing entirely with death.*"

There are, however, cases where dead organic matter retains its luminosity, as it is recorded in this work.

We may mention that the breast of a heron seems to have a strange fascination for fishes, in daylight as well as in the dark.

Mr. Holder quotes the statement of Dr. Dubois that the light of the fire-fly (*Pyrophorus*) has an exceedingly beautiful spectrum, "continuous, without dark or brilliant rays; and that appears most remarkable, the composition of the light was found to change with its intensity." Mr. W. G. Levison, of Brooklyn, has examined the light of the fire-fly (species not stated) and gives a rather different account. He finds that the blue and the violet rays are absent and that the less refrangible rays predominate. It is very probable, however, that the light of different species is not identical. A spectroscopic examination of the lights, as far as practicable, of all phosphorescent substances is urgently needed.

On the vexed question of the lantern-flies (*Fulgara lanternaria*) of South America, and *F. candelaria* of China Mr. Holder suspends judgment. Modern scientific opinion, certainly, is against the luminosity of this fine insect, but it is difficult to set aside the positive assertion of Madame Merian, who in many cases has been found to be an accurate and trustworthy observer.

The uses of phosphorescence are the subject of an interesting chapter and must be left to the decision of future observers.

The author states in his preface that his work is mainly addressed to young scientists, to their unscientific elders, and to the boys and girls who have not yet been led to feel an interest in Nature's works. We believe that it is well adapted to lead such persons on to become observers, and hence, as a whole, it is fairly entitled to whatever commendation we can bestow. The plates are not only beautiful but appropriate.

The Rothamsted Experiments on the Growth of Wheat, Barley, and the Mixed Herbage of Grass Land. By William Fream, B.Sc., F.L.S., etc., etc., Professor of Natural History in the College of Agriculture, Downton, Salisbury. Published by Horace Cox, *The Field* Office, Strand, London, W.C. 1888. 8vo, 235 pages.

This book is founded on facts accumulated during more than forty years of accurate scientific experimentation, is nearly unique, and must almost necessarily be of great value. It contains the results of the far-famed researches in agriculture which have been, and are still being conducted by the eminent investigators, Sir J. B. Lawes and Dr. J. H. Gilbert. The very numerous reports of these gentlemen are spread far and wide in a multitude of publications, and although extremely valuable, they are as a whole practically inaccessible; moreover, a good many of them are out of print, and from these circumstances they would in a few years be lost to the public.

Fortunately, in Professor Fream there has been found a faithful and competent interpreter of these valuable memoirs, and in the present volume he sets before his readers a terse and clear account, not only of the Rothamsted experiments on the growth of wheat, barley,

and grass crops, but also of the numerous important practical lessons which these experiments teach.

The volume treats of the cultivation of the crops in question under various conditions of season, climate, and manuring. It shows the effects of such cultivation on the quantity of the crops produced; on the quality of the grain, straw, and hay; on the proportions of the chemical constituents of the harvested plants; and, in the case of hay, on the botanical characteristics of the entire annual produce. When we add that in all cases crops were grown without manure, with mineral manures alone, with nitrogenous manures alone, with various complex manurial mixtures, with farmyard manure, and with different proportions of these manures, our readers will easily understand how extensive and varied is the information in this book. It must interest all who wish to understand the application of science to the discovery of the subtle operations of nature which are going on around us and produce such valuable results to mankind.

Noting some facts, we see that artificial manures, judiciously applied, are more economical than farmyard manure. Hence 5 lbs. of nitrogen, in the form of ammoniacal salts, will produce an increase of 1 bushel of 60 lbs. of wheat grain, or $2\frac{1}{3}$ bushels = 122 lbs. of barley grain, whilst 12 lbs. of nitrogen, as farmyard manure, would be required to produce the same effect; hence 400 lbs. of the former are equal to 14 tons of the latter in effect. Numerous other points of much interest are discussed.

We cannot possibly do justice to this volume in this short notice, and therefore we hope to call attention to this interesting work again in the near future; but in the meantime we recommend it to our readers as a most valuable little book on the subjects of which it treats.

We consider much credit is due to the author for the zeal and thoroughness with which he has accomplished his task; the tables, index, and prominent sub-headings all strike us as very useful, and illustrate the care and forethought he has exercised in this compilation.

Sir John Lawes and Dr. J. H. Gilbert have accepted the dedication of the volume, and in doing so testify the satisfaction they feel with the author's rendering of their valuable contributions to science.

Proceedings of the United States National Museum. Vol. IX. 1886. Published under the direction of the Smithsonian Institution. Washington: Government Printing Office.

This goodly volume gives full proof of the activity of the United States National Museum.

We notice in particular a paper by Mr. T. W. Blakiston on the "Water-Birds of Japan." The writer considers that so far as its fresh-water birds are concerned Japan is Eurasian (probably palæarctic), and as regards its marine birds, "Asio-Pacific"—a term which we cannot identify with any of the Sclater-Wallace regions in animal geography. We find here also the curious remark that Japan's "water-ornis" is as it should be. The term "ornis" may be judged from the connection and from its etymology to mean "bird-fauna." But it strikes us as a needless neologism.

Senor Fernando Ferrari-Perez communicates a catalogue of animals collected by the Mexican Exploring Commission. We note here a most unfortunate accident. A steamer conveying 123 boxes of specimens on their way to be identified by comparison with specimens in the Washington Museum was destroyed by fire. Among the mammals only two feline species are recorded, *Felis tigrina* and *Lynx rufus*, popularly known as the short-tailed mountain-cat. No bear is mentioned.

Among the birds we find recorded nine specimens of humming-birds, including, of course, the common *Trochilus colubris*. There are three trogons and three parrots.

There is no mention of a harpy eagle, which might have been expected to occur.

The serpents are fairly numerous, including *Boa imperator*, five *Crotalidae*, and three species of coral snake (*Elaps*)

Among the lizards we find no mention of the genus *Heloderma*, some species of which are reputed as venomous. Under the Crocodiledae figures only *Alligator Americanus*, here confusingly styled *Crocodilus*. In non-vertebrate animals, which present a much wider scope for research, nothing seems to have been done.

Mr. Leonhard Stegneger recognises the British marsh-tit under the name *Parus Britannicus* as a species distinct from *Parus palustris*.

Mr. J. B. Smith gives a revision of the Lepidopterous family *Saturnidae*, under which he recognises two sub-families, *Attacinae* and *Saturninae*. The former group, which the author considers as reaching the highest point in Bombycide development, are divided into the genera *Samia* and *Attacus*, whilst the latter group includes the genera *Actias*, *Telea*, *Saturnia* proper, *Calosaturnia*, *Hyperchiria*, and *Coloradia*.

Cleveland Institution of Engineers. Session 1887-88. No. 2.

This issue contains an important paper by Mr. Jer. Head on the "Iron Mines of Bilbao." It appears that the substitution of steel for wrought-iron in the manufacture of rails, in ship-building, etc., has had some results not altogether of a favourable character. Of the iron-ore raised in Britain in 1885, not more than one-sixth was of a quality suitable for conversion into steel. Hence, many of our mines are idle. The high-class ores, hæmatites produced in this country amounted only to 2,678,000 tons, whilst 2,817,000 tons were imported from abroad. Of this quantity 73 per cent. came from Bilbao. Hence the iron mines of that district are naturally a subject of interest to all persons connected with engineering operations.

College Hall.—This hall, which is situated in Byng-place, Gordon-square, was instituted for the purpose of providing for women students of the University College and the London School of Medicine the advantages of a collegiate residence. Byng-place consists of three large and commodious houses, of which two have for some time been in the possession of the founders of the Hall. The third house has been recently acquired, and the three are now capable of accommodating thirty-three students. There is a library, a dining hall, and a spare room, which can be isolated in case of sickness; and a recent report shows that fifty-four students have resided in the Hall since its opening, including a few "occasional students" for the period of their examination. Besides the course of study pursued by the lady residents outside its precincts, private tuition is given in the Hall in Latin, German, physics, and physiology. The debt owing by the Council for the alterations and additions to the premises now amounts to £1,200, and it is hoped the public, "having now received proof of the value to women students in London of the collegiate life supplied by the Hall, will give substantial support" to their appeal.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on March 8th, the following communications were read :—

"On some New and Typical Micro-organisms obtained from Water and Soil." By Grace C. Frankland and Percy F. Frankland. Communicated by Professor T. H. Huxley.

The authors have already given a detailed description of a number of micro-organisms—bacilli and micrococci—which they had obtained in the course of investigations on the distribution of micro-organisms in the atmosphere. The present paper deals with micro-organisms which they have derived from various natural waters. The authors point out the striking difference between the aërial and aquatic micro-organisms, micrococci being the predominant forms amongst the former, whilst bacillar forms are almost exclusively present in water. It was found that whilst none of the forms described oxidised ammonia either to nitrous or nitric acids, several of them exerted a powerfully reducing action on nitrates, others were without any action on the nitric acid, and others again caused the disappearance of an appreciable proportion of the nitric acid without production of a corresponding amount of nitrite. The authors allege that these differences in the behaviour of micro-organisms when introduced into solutions containing nitrates furnish very important data for distinguishing between approximating forms. Thus *Bacillus subtilis* and *Bacillus cereus*, though closely resembling each other, can be easily distinguished by the behaviour which they respectively exhibit towards the nitrate-solution. The *Bacillus subtilis* has no action on the nitric acid which can be quantitatively recovered, whilst the *Bacillus cereus* powerfully reduces the nitrate with formation of nitrite. The solution employed for the purpose of these experiments contained potassium phosphate, magnesium sulphate, calcium chloride, calcium nitrate, invert sugar, peptone, and an excess of calcium carbonate.

The following is a brief account of the descriptions given of the various micro-organisms :—

Bacillus arborescens is a slender bacillus giving rise to wavy threads, sometimes of considerable length. No spores were observed. In drop cultivations it is seen to be vibratory. On potatoes it produces a fine deep-coloured orange pigment. On nitrates it has no action in the solution employed.

Bacillus aquatilis is a slender bacillus also giving rise to wavy threads. No spores were observed, and the individual bacilli are seen in drop cultivations to exhibit only an oscillatory motion. It grows with great difficulty in all the media employed, with the exception of the aqueous solution, in which it grows abundantly, but does not reduce the nitrate.

Bacillus liquidus is a short fat bacillus of very variable dimensions. It produces on potatoes a thick flesh-coloured pigment. It reduces the nitrate powerfully in the solution employed.

Bacillus vermicularis is a large bacillus with rounded ends, giving rise to extensive vermiform threads. It produces fine oval spores, and has a strong reducing power.

Bacillus nubilus is a fine slender bacillus, which gives rise to wavy threads. Its growth in the solution effects the reduction of a very small proportion of the nitrate to nitrite.

Bacillus ramosus is a large bacillus much resembling *B. subtilis*, giving rise to long threads and spores, which are, however, rounder in shape than those of the latter organism. When grown on potatoes, it forms a dry continuous surface expansion, which is nearly white. It exerts a powerful reducing action on nitrates in the solution employed.

Bacillus aurantiacus is a short fat bacillus of very variable dimensions. On gelatine plates it produces bright orange pin-heads, but on potatoes it gives rise to a brilliant red-orange pigment, extending not far from the point of inoculation. It reduces the nitrates to nitrites only very slightly in the solution employed.

Bacillus viscosus is a short bacillus about three or four times as long as broad, occurring mostly in pairs. It very rapidly liquefies the gelatine, rendering it very viscid, and colouring it green. On agar-agar the whole surface quickly turns green. No reduction of the nitric acid takes place.

Bacillus violaceus is a bacillus varying in thickness, and produces on agar-agar a fine dark violet expansion. It powerfully reduces nitrates to nitrites.

Bacillus diffusus.—A fine slender bacillus recurring frequently in pairs, and giving rise occasionally to long undulating threads. It slightly reduces the nitrates to nitrites.

Bacillu scandicans. Sometimes this bacillus has almost the appearance of a micrococcus, at other times it shows a tendency to grow into short threads. When grown on gelatine plates it produces surface expansions much resembling drops of milk.

It grows abundantly in the aqueous solution, but exerts no reducing action on the nitric acid.

Bacillus scissus.—In form this organism much resembles *Bacillus prodigiosus*. It produces pale light green surface expansions on gelatine plates. In tubes the gelatine and agar-agar become tinted green. It powerfully reduces nitrates to nitrites. Of the above, the first nine were derived from water, whilst the remaining three were obtained from garden soil.

"Further Observations on the Electromotive Properties of the Electrical Organ of *Torpedo marmorata*." By Francis Gotch. Communicated by Professor J. Burdon Sanderson, F.R.S.

The author details the results of experiments on the electromotive properties of the electrical organ of the Torpedo carried out in October, 1887, at the laboratory of the Société Scientifique d'Arcachon.

From du Bois-Reymond's experiments it would appear that the organ possesses the remarkable property of conducting an intense current of short duration, led lengthwise through its columns, better when the current is directed from its ventral to its dorsal surface than when directed the reverse way. The former direction coincides with that of the current of the shock of the organ, and is therefore termed by him "homodromous;" the latter being opposite in direction, is termed "heterodromous." The evidence rests upon the value of the galvanometric deflections obtained when both currents are allowed to traverse a strip of organ and a galvanometric circuit. The deflections are markedly unequal, particularly when induced currents are used, the homodromous effect being always much greater than the heterodromous. The homodromous current must there-

fore either encounter less resistance than the heterodromous, or its electromotive force must be suddenly strengthened, and that of the heterodromous current weakened, by the sudden establishment in the tissue of a new source of electromotive energy. The first is the view taken by Professor du Bois-Reymond.

The author, however, from his experiments is led to assume that the phenomena of irreciprocal conduction are in reality excitatory phenomena, the nature of which, from the methods of investigation used, have not been recognised.

The second part deals with entirely novel phenomena, namely, the excitation of the organ by the current of its own excitatory state. It is shown that in vigorous summer fish every response of the whole or part of the organ to a single excitation of its nerves is followed by a second response, due to the passage through its own substance of the intense current of the first response. In other words, the shock of the organ excites its own nerve fibres and nerve endings, producing a feebler second shock, which in a similar manner evolves a feebler third shock ; this a fourth, and so on.

The response of the isolated organ to nerve excitation is thus multiple; a primary, secondary, tertiary response following the application to the nerve of a single stimulus. Since all these responses produce currents similarly directed through the columns of the organ, each column during its activity must reinforce by its echoes the force of the primary explosion, both in its own substance and also in that of its neighbours.

ROYAL INSTITUTION.

On March 8th the Rev. Dr. Dallinger, F.R.S., delivered the first of a course of three lectures on the "Least and Simplest Forms of Life." The lecturer, who is generally known as one of the most eminent microscopists of the age, drew in the outset a comparison between the phenomena of the heavens, infinite in their vastness, and the minute forms of organic life, almost infinitely small. In describing these organisms, he mentioned that a hollow cube, not greater in its dimensions than the diameter of a human hair, could contain 100 millions of the largest species of such beings. He showed the importance of these micro-organisms in the economy of nature, since without their agency the remains of dead animals and plants would, under many circumstances, constitute a mere encumbrance, instead of being, as now, made the basis of new life. Whilst, however, putrefaction is fermentation, a distinction was drawn between ordinary fermentation and that saprophytic fermentation which we commonly speak of as putrefaction. In the former kind only one micro-organism is at work, and the ultimate product is a definite organic compound. In the latter the process is accomplished by a definite series of minute organisms, which take up the task in succession, the final result being the complete decomposition of the organic matter, and its resolution into such single non-organic substances as water and carbonic acid. In such climates as occur between 50° and 70° N.L. the work of thus breaking up animal matter placed in water is effected by ten species of microbia. The structure of these organisms, as now ascertained by the use of the new objectives made by the skill of Zeiss, working according to the calculations of Professor Abbe, was compared with that as seen even under the best microscopes in use five years ago. Dr. Dallinger, on submitting some water which he had supposed was totally exhausted of all putrescible matter for a few days at a temperature of 90° F., was surprised to find still two other kinds of microbia, hitherto unknown, which seem to have the especial duty of working up any remaining fragments of organic matter. The lecturer had examined all these minute beings and their functions from a purely biological point of view, but he reminded his hearers that a chemical study of the products successively generated by these saprophytes remains to be undertaken, and that it would doubtless throw important lights on sanitary questions.

ROYAL GEOGRAPHICAL SOCIETY.

On the 12th inst. Mr. Douglas W. Freshfield read a paper on "The Peaks, Passes, and Glaciers of the Caucasus."

Mr. Freshfield gave an account of the results of a visit he made to the Caucasus last summer, in company with the well-known Hungarian geographer and Alpine climber, M. de Dechy. Mr. Freshfield was one of the early explorers of the Alpine portion of the Caucasus, having visited it first more than twenty years ago. Mr. Freshfield dealt mainly with that portion of the Caucasus chain between Elbruz and Kazbek, the Central Caucasus. That portion is 120 miles long, and from Naltshek to Kutais 100 miles broad. With regard to the glaciers of the Caucasus, Mr. Freshfield stated that they are many, and some of them are enormous. From imperfect Russian surveys it is usually stated in the text-books that the Caucasian glaciers are few and small; Mr. Freshfield showed that this is a complete mistake. Comparing the Caucasus with the Alps, he maintained that the Central Caucasus is much steeper than the Central Alps. The Alps for purposes of discovery, Mr. Freshfield maintained, are played out; in the Caucasus there is a fresh field not only for the mountain climber, but for lovers of grand scenery, as well as for the naturalist, the geologist, and ethnologist. Mr. Freshfield gave many details concerning the populations of the Caucasus, about which many erroneous notions still prevail. He described at some length his ascent of Tetnuld, a peak considerably over 16,500ft. above the sea level. There was no great difficulty, but the expedition was a very fine one. Speaking of what he saw in his descent, from a height of 13,500ft., looking down on the great basin of the Bezingi Glacier and the mighty peaks that encircled it, Mr. Freshfield said that the scene which burst on his view was of overpowering grandeur.

BRADFORD NATURALISTS' SOCIETY.

At the meeting held on February 27th, Mr. B. Illingworth gave an interesting and instructive lecture on "Life-histories of some of the Lepidoptera." Mr. Illingworth confined his remarks to those species that were the easiest to collect, beginning with the small Tortoiseshell Butterfly *Vanessa urticæ*, a species common throughout Britain. This insect passes the winter in the perfect state, and pairing does not take place until spring. After which the female deposits her eggs in masses on leaves of the common nettle, and the young caterpillars when hatched remain gregarious for some time, after which they disperse over the whole bed of nettles until full-fed, when they assume the chrysalis condition, the perfect insect emerging towards the end of June. The Peacock Butterfly *V. Io.* also feeds on

nettles, and has a similar life-history. The Red Admiral *V. atalanta* is also a nettle feeder, but differs in depositing its eggs singly, and the young caterpillars make a sort of domicile by rolling around itself a nettle leaf; after eating a portion it removes to another, and the same process is repeated until the caterpillar is mature. In speaking of the Northern Brown Butterfly *Erebia blandina*, he stated that it was abundant in Grass Woods, Grassington, and that it was not taken further south in Britain. The Orange-tip Butterfly *Anthocaris cardamines* was next dealt with, a species somewhat generally distributed, but in this district remarkably scarce, although it was stated that it formerly occurred in plenty in the neighbourhood of Saltaire. Amongst the various moths dealt with were the Gooseberry or Currant Moth *Abraxus grossulariata* which often does much injury to gooseberry or currant bushes in the larvæ state, the Oak Eggar Moth *Bombyx callunæ*, and the Emperor Moth *Saturnia carpini*. Of the two latter Mr. Illingworth has had considerable experience in rearing them through their transformations, and observing their habits, which are somewhat remarkable, especially that of assembling, which is perhaps the most curious phenomenon connected with insect life. If a living female example of either of these species be taken on to the moors in April and May the males are attracted in large numbers, and according to Mr. Illingworth's observations will come from a distance of nearly two miles. In speaking of the Cinnabar Moth *Euchelia Jacobææ*, a most brilliant insect, he stated that at Skegness it occurred in vast numbers, and in the month of July nearly every plant of Ragwort, its natural food, is tenanted by scores of the yellow black-banded caterpillars. The Gipsy Moth *Liparus dispar* he stated was extinct in Britain, but in France it was extremely abundant. It is remarkable for the manner in which the eggs are deposited and protected, the female moth placing a layer of down from her body between each layer of eggs as a protection during the winter. It is a species very easy to rear, and the lecturer distributed a number of eggs amongst the members for this purpose.

ROYAL SCOTTISH SOCIETY OF ARTS.

At the meeting held on February 27th the committee's report on the paper read at a former meeting by Mr. John Reid, Rosemount, was submitted. The object of the paper was to show a means of saving water in hydraulic hoists, by making it possible to approximate the quantity of water used to the load to be lifted. Hydraulic hoists, the committee explained, were generally constructed with a single ram and cylinder, and the ram being made sufficient for the maximum load to be lifted, it followed that the quantity of water used was the same whether the hoist raised the full weight or only a small part of it. In hoists with variable loads there was consequently a great loss of power, and to obviate this Mr. Reid had proposed to use three smaller rams and cylinders, with an aggregate power equal to the single ram and cylinder—the centre ram to be used for light loads, the two outer rams for intermediate loads, and all three rams locked together for the maximum load. This separation of the rams was the novelty of the paper. Though considering that in certain particulars the paper was not fully worked out, and that it would not be advantageous to have more than one ram in small hoists, the committee were of opinion that in large hoists, triplicate rams, as advocated by Mr. Reid, if properly arranged and constructed, would be the means of a considerable saving of power. A paper "On the Regulation of the Compensation Balance of Timekeepers," written with the view of showing how the operation might be simplified and made more accurate, was also read, the subject being treated in a purely technical manner.

LIVERPOOL MICROSCOPICAL SOCIETY.

At the meeting on March 2nd, a communication from Mr. George Thomas, entitled "A Few Notes on Microscopic Eyepieces," was read by the secretary. Mr. Isaac Thompson then read a paper upon "Some New and Rare Species of Copepoda, recently found in Liverpool Bay." Since the establishment of the Liverpool Marine Biology Committee by Professor Herdman, some three years ago, a vast amount of work had been done towards investigating and tabulating the marine life of our neighbourhood. Mr. Thompson had worked chiefly at the copepoda, a large class of microscopic crustacea animals, somewhat resembling very minute shrimps, and in his paper described some of the new and rarer species recently found. Until the Liverpool Marine Biology Committee was established, only six species of marine copepoda had been recorded in this district, the number having since reached over fifty. Of these, four species are new to Britain, and three are altogether new to science. Two of the other species had not been before recorded in Britain for fifty and thirty years respectively. Among the new and rarer forms described were *Cymbasoma herdmani*, *Cyclops puffini*, and other new species found about Puffin Island; *Eurytemora hirundo*, Giesbrecht, a copepod new to Britain, found in Crosby Channel; *Euterpe gracilius*, Claus (copepoda), a very rare species found about Puffin Island; *Isica clavipes*, Boeck, occasionally taken in Liverpool Bay; *Lichomolgus sabellæ*, a new semi-parasitic copepod, recently found at Beaumaris; *Longipedia coronata*, Claus, common about Puffin Island; *Paripontella brevicornis*, Lubbock, occasionally taken about Puffin Island; *Peltidium interruptum*, Goodsir, often found in rock pools at Hilbre, &c.; *Temora velox*, Lillieborg, a brackish water species found at Leasowe, &c.; *Pontella wollastoni*, Lubbock, hitherto very scarce, recently plentiful about Puffin Island; *Trebius caudatus*, Kroyer, a parasitic copepod, recently taken by night tow-net off Puffin Island.

The recent cold temperature had appeared to favour the presence of species not found in warmer water, and other forms had been found only on dark winter nights. The regular series of observations now being undertaken would probably prove of great interest and of value in many ways. One of these was as to food supply. It was well known that the copepoda lived upon refuse matters from our shores and rivers, thus preventing pollution, and showing that the question of the disposal of sewage was biological rather than chemical. And as copepoda were allowed to increase and multiply, not only were our rivers purified, but furnishing, as they did the chief, if not entire, food of fishes and even whales, they were of the greatest benefit to mankind both as efficient scavengers and as valuable food producers. Mr. Thompson concluded by recommending the microscopical study not less of the fresh water forms of copepoda than the marine. He believed there was still much original work to be done regarding them, and they were to be found in every pond.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

On March 8, Mr. Carrington read a paper on the British *Salmonidae*, with particular reference to the salmon, the trout, the char, and the grayling. Many interesting facts were mentioned concerning the remarkable changes produced in these fishes by removal to a different climate, or even by transfer to a river of a different character. Hybridisation is very successful among different species of this genus, and one of the forms thus produced promises to be of practical importance. The fish in question reach the weight of 13-14 lbs. and have the great advantage over the salmon that it remains all the year round in lakes or streams without needing or seeking to return to the sea. An interesting species of the *Salmonidae* is the "pullen" or "fresh-water herring" of Lough Reagh, which is rarely met with in the London market.

GLASGOW NATURAL HISTORY SOCIETY.

At the meeting held on the 28th ult., Dr. Marcus Calder exhibited living specimens of the black rat (*Mus rattus*), a species which was formerly abundant in this country, but has become almost extinct within recent years, although single individuals are sometimes obtained in the vicinity of seaports. It is believed to have been extirpated by the common brown rat (*Mus decumanus*), a larger and more powerful species, which has rapidly spread over the country. Dr. Calder stated that the specimens had been captured at Greenock, where the black rat has been re-introduced, probably through the agency of shipping, and is at present rather abundant in one part of the town. Mr. A. Somerville, exhibited a specimen of *Trophon truncatulus var. scalaris*, a gastropod shell dredged by him in 40 fathoms off the Soay Isles, Iona. In the course of some remarks, he stated that the type is commonly met with throughout the West of Scotland, and more sparingly further south, but the variety has hitherto been regarded as a Norwegian or Arctic form, not occurring further south than the Shetland Isles. Mr. A. Somerville, B.Sc., F.L.S., read a paper on a day's dredging in 30 and 44 fathoms mud, off Portincross, Ayrshire, and submitted a list of the shells obtained, which included several rare and interesting species.

QUEEN'S COLLEGE, BIRMINGHAM.

Professor Tilden, in a lecture delivered recently, said: Imagine a globe about 6ft. in diam. coated with a layer of liquid 1-20 to 5oin. thick, and with a layer of gas ¼in. thick, we should then have a model which would roughly represent the earth with its oceans of water and air. And just as the waters of the sea consist not of pure water, but of water mixed with various and varying quantities of solids and gases dissolved out of the earth and air, so the atmosphere consists of a mixture of two principal gases mixed with small quantities of other substances, solid, liquid, and gaseous, derived from the earth. The two chief components of the air are oxygen and nitrogen, in the ratio of about one-fifth oxygen to four-fifths nitrogen. The former was distinguished by the old chemists from Priestley's time as "vital air," a sufficiently expressive name when we remember that it is indispensable to life. Beside the normal constituents given we have other ingredients always present throughout every region of the atmosphere, even in the mountains and in the open country, far away from man and his works, and these also contribute in various ways, not wholly understood, to the general effects of the atmosphere. Of course local and temporary changes are produced where many people are congregated together as in towns and crowded buildings. Under such circumstances we get not only a diminution of oxygen, but an increase of carbonic acid, and especially of those indefinable organic matters the presence of which is certainly very deleterious. The variation to which the proportion of oxygen is liable lies within very narrow limits. According to Dr. Frankland's analyses, air from the top of Mont Blanc contains about 20.9 volumes of oxygen in 100 volumes of air, whilst very bad air from the tunnel of the Metropolitan Railway was found by Angus Smith to contain 20·6 volumes of oxygen. The variation in the carbonic acid is more obvious. Whilst pure country air contains about 3 to 4 volumes of this gas in 10,000 of air, the air of crowded rooms, in mines, and in tunnels, often contains 15, 20, or 25 volumes of carbonic acid. A number of experiments were made at the Mason College in 1883, with the object of testing the effect of lighting the Town Hall with electric light in place of gas. It was found that the air on crowded nights contained about 20 volumes of carbonic acid, and that there was no marked difference when the electric light was used. But this is explained by the fact that the heat of the gaseliers caused a strong upward current of air through the ventilators. Now, in regard to the impurities, it is only necessary to look at the pall of smoke overhanging every town to understand something of its effect in shutting off the light of the sun. And if we want to know what is present in it, we need only catch a little rainwater and evaporate it down, when crystals containing ammonia, with hydrochloric acid and especially sulphuric acid, can always be obtained. And in connection with this matter it is not alone the manufacturer whose chimney are to blame, though it would be easy in this town to point to cases where, in defiance of every legal and moral consideration, and disregarding the injury to other people's health and property, dense columns of black smoke are daily discharged into our very streets. The present system of burning coal in open grates—a system dear to the British householder, who likes to have a fire he can poke—is really the cause of the evil. That the evil is a serious one is obvious when we observe that London is rapidly becoming uninhabitable at times which are not now as formerly confined to the dark months of November and December. It has long been a favourite idea with me that private chimneys ought not to be allowed. The smoke together with the air from sewers should pass together through underground culverts, where the soot would be deposited, and the gases, then comparatively harmless, should be delivered up tall shafts (which might be made as ornamental as church spires and towers), 100 feet or more above our heads. Such a system would require very little alteration in the structure of existing houses, and would be easily carried out in new ones. But no change of this kind is likely to be brought about until the public is better instructed about such matters, and until a general recognition of the evils of the existing state of things leads to some united action.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held at Westminster Town Hall, on March 5th, Mr. A. T. Walmisley

President, in the chair, a paper was read on "The Effect of Sea-water on Portland Cement," by Henry Faija, M.Inst.C.E.

The paper referred to the failure of certain concrete work at Aberdeen Graving Dock, and the author first alluded to the several published reports ascribing the failure to the chemical action of the sea-water on the cement. After pointing out that Portland cement has been used in marine works for forty years, and that until now any failures that may have occurred have never been traced or ascribed to the chemical action of the sea on the cement, the author gave a general description of the work carried out at Aberdeen, embodying extracts from the reports of Mr. Smith, Professor Brazier, and Mr. Messent, descriptive of the manner in which the cement was used, the specification to which it was supplied, and the argument on which their theory is based —which is, briefly, that the magnesia precipitated from the sea-water enters into and becomes a compound part of the cement, thus destroying it. The presence of magnesia in cement was then considered, and the reason explained why it is deleterious, when in excess, but the magnesia as precipitated from the sea-water was shown to be in a very different condition to magnesia when it is incorporated in a cement in the course of manufacture. The result of a large number of experiments, comparing the behaviour of cement when gauged in sea-water and when gauged in fresh water, the analyses of the cements before and after gauging, and of the scale on the surface, together with the scum and sediments in the waters in which the cement had been placed, were given.

The specification and the analysis of the cement used at Aberdeen were then considered, and it was pointed out that, though such a specification was not antagonistic to the production of a good cement, there was nothing in it which ensured a good and sound cement being delivered, and it was suggested that one or other of the methods now known for determining the soundness of a cement should in all cases be used, the author being of opinion that, given that a cement is well ground, and is proved sound, it will, in nearly all cases, be strong enough for any purpose for which it is likely to be used. The concrete at Aberdeen was used in what is called a "plastic" form—*i.e.*, it was allowed to partially set, and was then broken up and placed in position. The danger of using cement in this manner was shown, and the results of several experiments given, proving that under certain conditions the cement never resets.

The conclusions arrived at were that sea-water has no deleterious chemical action on a sound and properly used Portland cement, and that the failures at Aberdeen must be attributed to some other cause; either to an inherently bad cement having been used, or to the injudicious use of it in a plastic form.

LIQUID BLACKING.— A well-known liquid blacking is composed in the following manner:—Very finely ground animal charcoal, or bone black, is mixed with sperm oil till the two are thoroughly commingled. Raw sugar or treacle mixed with a small portion of vinegar, is then added to the mass. Next, a small measure of dilute sulphuric acid is introduced, which, by converting into sulphate a large proportion of the lime contained in the animal charcoal, thickens the mixture into the required pasty consistence. When all effervescence has subsided, but while the compound is still warm, vinegar is poured in until the mass is sufficiently thinned, it is ready to be bottled for the market.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

"A PECK OF MARCH DUST IS WORTH A KING'S RANSOM."

The true explanation of this old saying is lost sight of in the SCIENTIFIC NEWS, March 16th, commencing with the query, "Why should dry, windy weather be so valuable just now?"

Some of the theories mentioned are, no doubt, correct, but the main point is that, before barley and some other seeds can be satisfactorily sown it is most important that, to ensure good results, the soil shall be in such a state of tilth that a certain amount of dust can be seen to arise when it is stirred by the harrows and drill. Spring corn, sown under these conditions, germinates more regularly, and probably means several sacks per acre more when harvested.

This, calculated over a district, will amount to a sum sufficient to ransom a king of the olden time, when the price per sack was double what it is. The farmer now anxiously looks for the appearance of the peck of dust.

ALFRED TAYLOR.

MEAN VELOCITY OF THE WIND.

Your correspondent, J. Reginald Ashworth (SCIENTIFIC NEWS, February 17th, p. 165) seems to doubt my statement that "in our days smoke very rarely either rises or falls, but is hurried along." My general impression is that the air is sufficiently tranquil to admit of the smoke rising or falling only during the brief "slack" which prevails when either the polar or the equatorial current is dying away and about to give place to its antagonist. But knowing the danger of trusting to general impressions I have, since reading Mr. Ashworth's letter on February 18th, entered daily in my diary the character of the wind. I find that out of the twenty-five days included there have been only three days when the smoke could be said to ascend perpendicularly, and by day when it was doubtful. My observations were made on a number of chimneys in a northern suburb of London, including one factory-chimney considerably higher than any of the surrounding houses.

CLOUD-GAZER.

It seems to me that the behaviour of smoke as it leaves the chimney may have been affected by other factors besides the windiness or calmness of the weather. In the country hamlets, where the old weather proverbs were concocted, the chimneys would be low and the houses very frequently sheltered by trees. Hence there would be in those days much greater possibility of the smoke issuing quietly and rising or falling, as the case might be, than now they are much loftier, and the vicinity is laid bare of trees—the only effectual screen against the wind.

THIRDSMAN.

INFLUENCE OF OCCUPATION ON HEREDITY.

The observations made by your correspondent "W" are very interesting, and deserve to be repeated wherever there is opportunity. Although I cannot give chapter and verse, I fancy that I have met with similar or, at least, analogous cases.

JEROME.

DO BIRDS AVOID POISONOUS FRUITS?

So says general opinion. On the other hand a popular and somewhat sensational writer on natural history declares that the berries of the arum are brilliantly coloured on purpose to attract birds, which eat them and die, whilst their decomposing remains furnish a rich manure for the seeds. But we cannot find that he has ever met with a dead bird in the autumn, and found the berries of the arum in its crop. On the other hand, it is well known, that grain-eating birds may be destroyed by poisoned seeds scattered in the fields. Hence it would seem probable that birds become acquainted with the poisonous fruits naturally growing in their country, but that they have no mysterious faculty to warn them against danger presenting itself in some unknown form.

ARUSPEX.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

BOILER FLUID.—A fluid for preventing and removing boiler incrustation has been patented by Mr. J. Cooke, Folly Head, Huddersfield. It is prepared in the following way—1 oz. of Irish moss is dissolved in 3 lbs. of water, to which is added 4 ozs. of caustic soda, 2 ozs. of carbonate of soda, and 2½ ozs. of molasses.

A CARBON.—Mr. W. R. Johnstone, Clanchattan, Nairn, has patented a carbon. This invention consists in manufacturing carbons for electrical and other purposes by moulding moist paper pulps into the desired forms, subjecting it when necessary to pressure and afterwards drying and carbonizing.

GALVANIC BATTERY.—Messrs. M. Bailey and J. Warner, London, have patented a galvanic battery. It consists of a porous cell filled with a paste formed by mixing together plumbago and nitric or other "oxacid"; a carbon rod, with a terminal, is embedded in the paste, and the cell covered with a lid. Sometimes the carbon rod is made hollow and filled with nitric acid; or the paste may occupy the external cell and the zinc be placed in the internal porous pot.

LEVELLING APPARATUS.—An apparatus for levelling grounds for lawn-tennis courts has been patented by Mr. J. H. Walsh, Montserrat Road, Putney. The apparatus consists of a long trough, on which are mounted wheels and a handle. In levelling, say, a tennis lawn, the surface is covered with a fine dry mould, and the apparatus drawn along the ground—the trough being previously weighted with bricks, stones, etc., or with liquid, and the handle lifted so as to take the wheels off the ground.

ROAD SWEEPING MACHINE.—Mr. H. Whiley, Manchester, has patented a road sweeping machine. The leading feature of this invention is the employment of two revolving brushes mounted obliquely to the track, so as to sweep the street refuse into a line in the middle. At the centre, towards the rear, a train of brushes and elevator may be applied for collecting and conveying the refuse to a receptacle in front, where it may either remain for removal or, by means of a mechanically controlled false bottom, be deposited at intervals in heaps.

STRETCHER FOR PIANOFORTE WIRES.—An apparatus for stretching the wires of pianofortes has been patented by Mr. A. J. Creswell, of 12, Hucknall Road, Carrington, Nottingham. The invention consists of a lever pivoted near its centre on the downward projection of a T shaped metal bracket, a portion of the upper end of which, nearest the framing, is reduced to fit into the ordinary peg-hole of the piano framing, while the opposite end is provided with a fine threaded vertical screw, which acts on the outer end of the lever. The wire is attached to the lever at the end near the framing in a special manner, and by depressing the outer end of the lever, by means of the fine threaded screw, the requisite amount of tension may be obtained.

DISTANCE REGISTER FOR CABS.—Mr. H. P. Baron Celli, Kennet Road, St. Peter's Park, has patented a distance register for cabs. An eccentric is rotated by one of the wheels of the vehicle and actuates a rod with a slotted head, which is attached to it by means of a set screw. A "pin" on a lever fits into the slot and actuates, by means of the lever, a counter, which thus shows the distance from which the fare can be calculated. The ends of the slots are padded with india-rubber, or springs, to avoid shocks due to the wheel jolting. By loosening the head from the rod the counter may be actuated by hand before each journey, and thus set at zero, or the distance travelled may be determined by simple subtraction of the readings at the beginning and end of the journey.

GAS BURNER.—Messrs. J. F. and G. E. Wright, Essex Works, Aston, have patented an atmospheric gas burner. The pipe which forms the burner tube is cast with a longitudinal slot into which fits a tongue provided with grooves through which the mixture of gas and air passes. The tongue is made deeper at the end where the gas enters than at the other end up to which the bottom edge tapers; the grooves are also narrower at the entrance end. By this means the flow of gas is equalised all along the burner. The burner is pivoted in the framework of the stove at one end and supported in a bearing at the other, and by means of a crank worked by a lever it may be turned through an angle of about 90 degrees so that it may be used either as a boiling burner with vertical jets, or as a grilling or toasting burner with horizontal jets.

REGISTERING TILL.—Mr. J. S. Bobbett, London Road, Tunbridge Wells, has patented a registering till in which the registering paper-strip passes from one roller to another roller over the usual table under a slit in the lid of the case. These parts are mounted on a spindle, so that they can be revolved by turning a handle from outside, a detent checking the rotation at each half revolution by entering notches in a disc. The teeth of the wheel fixed on the spindle of the first roller engage with a fixed rail formed of two semicircles, one larger than the other, by the pitch of the teeth. When an entry has been made on the paper strip, the table and its attachments are turned half round for the customer to inspect the sheet, the teeth of the wheel sliding round the smaller semicircle, and no motion taking place in the strip. On continuing the revolution, the wheel is advanced one tooth, and a blank space on the paper strip brought under the slot in the lid. The spindle of the external handle, by which the revolution of the table is caused, carries two cams, one of which depresses the drawer catch. The drawer being then thrown open by a spring, the other actuates a signal bell by means of a sliding spring-bar carrying the hammer at one end; this bar also operates a flap by which the coin is retained for inspection, during a portion of the operation, behind a glass window.

NEW INSECT POWDER.—Air-slaked lime and carbolic acid, both valuable about the poultry yard as disinfectants or deodorisers, make a splendid insect powder if mixed in the proportion of a teaspoonful of liquid acid to a gallon of lime. On account of its cheapness, this powder may be used quite liberally in nests, in the dust bath, and on adult fowls, if necessary. It is also said to be a remedy for gapes—by placing the chicks in a box covered with muslin and dusting some of it through the muslin.

TECHNICAL EDUCATION NOTES.

AGRICULTURAL EDUCATION.—An inaugural meeting of the Agricultural section of the National Association for the Promotion of Technical Education was held on the 14th inst at Spencer-house, Lord Spencer in the chair, to consider the best means of promoting agricultural education. Among those present were Lord Balfour, Lord Lyttelton, Sir Henry Halford, Sir Lyon Playfair, M.P., Mr. F. de Laune, Mr. C. T. D. Ackland, M.P., Mr. Jesse Collings, M.P., Sir E. Grey, M.P., Mr. T. Ellis, M.P., Mr. H. S. Maskelyne, M.P., Mr. R. Munro Ferguson, M.P., and Mr. A. H. D. Acland, M.P. Lord Spencer was appointed chairman, and Mr. Ferguson, M.P., secretary; and it was resolved that a separate section of the Technical Association should be formed for the consideration of agricultural education, and that various other gentlemen be invited to join the committee.

COMMERCIAL EXAMINATIONS OF THE SOCIETY OF ARTS.—With a view of rendering these examinations more practical and technical, the Council has decided to examine candidates who have passed the general examination for Commercial Certificates in special subjects relating to different branches of commerce —For the present year it is proposed to hold an examination in two divisions:—I. The Commerce of Food; II. The Commerce of Clothing. Other divisions will be added as experience may show to be desirable, and these divisions will also be further expanded. The syllabus has been framed so as to correspond generally with the main divisions of trade, but it has not been found practicable to divide it up so that it may correspond with numerous branches into which every trade is divided. In both divisions candidates for examination will be expected to answer questions as to sources of supply of the various products, the countries producing them, their nature, method of preparation for market, characteristics, methods of testing, substances used in adulteration, values, methods of importation, cost and methods of transport, foreign markets, discounts, trade allowances, shipping insurance, customs duties, etc. When possible the candidate may be required to examine and report on samples of the goods. He must be familiar with the technical terms used in this branch of commerce, and will be expected to make out bills of lading, invoices, etc. The first examination will be held in London in June next. Further information respecting the examinations can be obtained on application to the Secretary of the Society of Arts, John-street, Adelphi.

TECHNICAL EDUCATION IN THE MIDDLE TEMPLE.—We learn from the *Electrical Review* that a meeting of a very interesting character took place in the Parliament Room of the Middle Temple recently. Some weeks ago the Treasurer of the Inn for the present year, Sir Henry James, submitted to the Benchers a plan for affording to the students instruction by means of lectures upon subjects not strictly of a legal character, such as mechanical science, electricity, chemistry, and medical jurisprudence. The Benchers having given their approval to the proposed plan, it was on Tuesday afternoon announced to the students. Sir Henry James, who was accompanied by Mr. Michael, Q.C., Mr. Macrory, and Mr. Morgan Lloyd, Q.C., briefly addressed the assembled students. He informed them that the object in view was to give them instruction in subjects the knowledge of which would be of great service to them in the practice of their profession. He announced that Mr. T. Aston, Q.C., and Mr. Moulton, Q.C., had most kindly volunteered to lecture upon mechanical science, chemistry, and electricity as applied to the industrial arts, while Dr. M. Tidy would deliver twelve lectures upon medical jurisprudence. The lectures will commence in Easter Term, examinations taking place, and prizes being given at the end of the year. The members and students of the other three Inns of Court were also invited to attend the lectures. The students, through one of their body, gratefully accepted the offered instruction, and proceeded to elect a small committee in order to co-operate with the Benchers in their laudable efforts on behalf of technical education.

ANNOUNCEMENTS.

MILITARY EXAMINATIONS.—A preliminary examination for admission to the Royal Military College, Sandhurst, and the Royal Military Academy, Woolwich, will be held in London, Edinburgh, and Dublin on the 13th and 14th of June, under the regulations for the Royal Military College, Sandhurst, dated August, 1887, and for the Royal Military Academy, dated December, 1887.

A YOUNG EXHIBITIONER.—A. W. Pickard-Cambridge has been placed first in Classics among the senior candidates at therecent Cambridge University Local Examination, and has in consequence been offered an exhibition at St. John's College, Cambridge. This young gentleman is only fourteen years old, and has won this distinction at an almost unprecedentedly early age. He is a son of the Rev. O. P. Cambridge, F.R.S., the distinguished naturalist, and has been a pupil in Weymouth College for about four years.

SCIENTIFIC RESEARCH IN FRANCE.—The French Association for the Advancement of Science has made the following grants for purposes of scientific research: 1,000 francs (£40) to M. Topinard, to aid him in completing his map showing the colour of hair and eyes in the different departments in France; 100 francs (£4) to Dr. Maurel for his researches on the causes of paludism; 200 francs (£8) to Dr. Léon Petit for the publication of the works of Jean Méry; 500 francs (£20) to M. Turquan for the publication of a statistical map of the French population.

INSPECTORS OF SCHOOLS IN SCOTLAND.—In consequence of the approaching resignation of Dr. Wilson, Her Majesty's Chief Inspector of Schools in Scotland and Inspector of Training Colleges, the Lords of the Scotch Education Department have nominated Dr. Kerr, Chief Inspector in the Western Division, as his successor. Dr. Ogilvie, Chief Inspector in the Northern Division, will be transferred to the Western Division, and Mr. T. A. Stewart, Her Majesty's Inspector, has been appointed to succeed Dr. Ogilvie as Chief Inspector in the Northern Division.

PEOPLE'S LECTURE SCHEME.—The concluding lecture of the course of three on "The Atmosphere in relation to Health," by Mr. V. B. Lewes, was given at the Stratford Town Hall on the 14th inst., under the presidency of the Mayor of Stratford. As on the two previous occasions, the hall, which holds about 1,500 people, was filled to overflowing, a large number of people failing to gain admission. The remarkable success of this short course is likely to lead to the establishment of a permanent centre in that district in connexion with the London Society for the Extension of University Teaching. Already between 150 and 200 names of students have been received by the committee.

BARCELONA EXHIBITION.—At the request of the Secretary of State for Foreign Affairs, the Society of Arts has undertaken to promote the interests of the Exhibition in this country, and to act as the intermediary between British exhibitors and the executive of the Exhibition. The Exhibition is announced to be opened on the 9th April, and the date for the receipt of applications from foreign exhibitors has already passed. A request for an extension of the time has been made to the Spanish Executive. In the meantime, British manufacturers who wish to take part in the Exhibition and have not already sent in applications for space may apply to the Secretary of the Society of Arts, John-street, Adelphi, W.C.

CAMBRIDGE.—At King's College the annual election of Fellows was held on the 17th inst. Amongst those chosen were John Henry Middleton, M.A., Slade Professor of Fine Arts; Arthur Pillans Laurie, B.A., second class Natural Sciences Tripos, Part I., June, 1883, first class Natural Sciences Tripos, Part II., June, 1884; Herbert William Richmond, B.A., scholar of the college, third Wrangler Mathematical Tripos, Parts I. and II., June, 1885, Mathematical Tripos, Part III., 1886, placed in Division I., Barnes University Scholar, 1883. At Clare College the following were elected to minor scholarships open to the competition of persons not yet in residence:—For Mathematics.—Lattimer, Carlisle Grammar School, £50; William Evans, Llandovery College, £50; Power, Charterhouse, £40. For Natural Science.—Watson, Clifton College, £50; Todd, Carlisle Grammar School, £50; Hughes, King Edward's School, Bromsgrove, £40.

DIARY FOR NEXT WEEK.

Monday, March 26.—Society of Arts, Cantor Lecture, at 8 p.m. —*Alloys;* Professor Chandler Roberts-Austen.
Bradford Naturalists' Society, at 7.30 p.m. —*British Rodentia;* Mr. F. Rhodes.
Birkenhead Literary and Scientific Society. —*The Prose Writings of Mr. Louis Stevenson;* Mr. John Paxton.

Tuesday, March 27.—Society of Arts, Foreign and Colonial Section.—*The Panama Canal;* Mr. J. Stephen Jeans.

Wednesday, Mar. 28.—Civil and Mechanical Engineers' Society, at 7 p.m.—*The Development of Machinery in relation to Hand Labour;* Mr. Ambrose A. Myall.
Cardiff Amateur Photographic Society, at 8 p.m.—*Lantern Slides and How to Make them;* Mr. W. Davies.
Dundee Naturalists' Society, at 8 p m.

Thursday, March 29.—Chemical Society Anniversary Meeting.
Camera Club, at 8 p.m.—*Stereoscopic Photography;* Mr. A. Stroh.

Friday, March 30.—Good Friday.
Camera Club. — *Elementary Lecture on Photography.*

Saturday, March 31.—

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Crayon Sketch from any photograph (returned uninjured), 15 by 11, 1s. 2d., free.—Mr. COULTHARD, Bathwick, Bath.

Patterns. — 100 fretwork; 100 repoussé; 200 turning; 300 stencils; 1s. each lot.—COLLINS, Summerlays-place, Bath.

Patents.—Nine months' protection, 50s.; patent completed from £6 10s.—P. M. ROGERS, 21, Finsbury Pavement.

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Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps. Castings, lamps, etc.; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s.; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch, London—All Letters, Britannia Tool Factory, Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new appliances, metal spinning, milling, etc., in an ordinary lathe; 3s. post free.—Britannia Company, Colchester.

Minerals.—12 named specimens, 2s. free; 12 lias fossils, 2s. 6d. —CHAS. WARDINGLEY, 30, Blackwood Crescent, Edinburgh.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

Charadriidae; or, Plovers, Sandpipers, Snipes, and their Allies. By Henry Seebohm. With numerous woodcuts. London: H. Sotheran and Co. Price £2 12s. 6d.

Natural History Object Lessons; A Manual for Teachers. By G. Ricks, B.Sc. London: Isbister and Co. Price 4s. 6d.

Elements of Physiological Psychology: A Treatise of the Activities and Nature of the Mind from the Physical and Experimental Point of View. By George T. Ladd. London: Longmans, Green, and Co. Price 21s.

Tenants of an Old Farm; Leaves from the Note Book of a Naturalist. By Henry C. McCook, D.D. London: Hodder and Stoughton. Price 6s.

Old and New Astronomy. By Richard A. Proctor. London: Longmans, Green, and Co. Part I. Price 2s. 6d.

Home Experiments in Science for Old and Young; Including Mechanics, General and Molecular Physics, Soap Bubbles and Capillarity, with Detailed Instructions in the Necessary Mechanical Operations and Illustrations of the Experiments and Apparatus. By T. O'Conner Sloane, E.M., A.M., Ph.D. London: Sampson Low, Marston, Searle, and Rivington. Price 6s.

Egyptian Archæology. By Prof. G. Maspero and Miss Amelia B. Edwards. With 309 illustrations. London: H. Grevel and Co. Price 10s. 6d.

Pocket Encyclopædia: A Compendium of General Knowledge for Ready Reference. 1,206 columns, upwards of 25,000 References. London: Sampson Low, Marston, and Co. Price 3s. 6d.

Mathematical Instruments: Their Construction, Adjustment, Testing, and Use Concisely Explained. By J. F. Heather, M.A. Fourteenth Edition Revised. With Additions by A. T. Walmisley, M.I.C.E. With Numerous Illustrations. London: Crosby Lockwood and Son. Price 2s.

Management of Accumulators and Private Electric Light Installations. A Practical Handbook. By Sir David Salomans, Bart. Third Edition. London: Whittaker and Co.

Treatise on Photography. By Captain W. de W. Abney. Fifth Edition. London: Longmans, Green, and Co. Price 3s. 6d.

An Easy Guide to the Constellations; with a Miniature Atlas of the Stars, and Key Maps. By the Rev. James Gall. London and Edinburgh: Gall and Inglis

NOTICES.

The Title Page and Index to Vol. I., *First Series,* now ready, price 6d.

Binding Cases for Vol. I., *First Series,* price 2s. each.

Binding Cases and Binding, Vol. I., *First Series,* including Title Page and Index, price 3s.

Vol. I., *First Series,* bound in cloth, with Title Page and Index, 7s. 6d.—by post 8s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Prices 6d. each, or by post 7d. for the *First Series,* and 3d. each, or by post 3½d., for the *New Series.*

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 13. (*New Series.*) MARCH 30th, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

A LECTURE WITH—AND WITHOUT—POINT. Which being interpreted by Sir Frederick Bramwell, at the Royal Institution, means that decimals should be sometimes used and sometimes not. The lecturer not only spoke strongly of the practical advantage of using vulgar fractions for nearly all purposes, but he poured scorn on the metric system. As was to be expected, the lecture was clever and witty, but it was hardly conceived in the scientific spirit which the subject deserved, and was too much of an *ex parte* statement to carry conviction. We entirely agree with Sir Frederick that for ordinary purposes it is much better to make use of such simple vulgar fractions as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, etc., instead of the rather cumbersome decimal equivalents. Such fractions also more readily lend themselves to addition, multiplication, etc., mentally than is possible with decimals. *Apropos* of this, the lecturer remarked that he had specially noticed in France and Italy that mental arithmetic was seldom if ever resorted to, and that even when the calculations were made on paper there were very frequent errors, owing to the misplacement of the decimal point.

Having a somewhat intimate knowledge of the system of education adopted in France, we cannot help thinking that the little use made of mental arithmetic is not so much due to the metric system as to the way in which arithmetic is taught. Generally speaking, a distaste for figures is engendered, and a mind thus prejudiced is little likely to resort to mental calculations, when they can be more easily done on paper. We might just as well find fault with our vulgar fractions, because the majority of women in this country dislike and do not practice mental calculation. With practice and aptitude it is not after all so very difficult to calculate mentally with decimals for ordinary purposes, as not more than one or two places of decimals are then required.

As to the convenience of the metric system, we think Sir Frederick Bramwell hardly did it justice. Compare, for instance, the addition of square metres, decimetres, and centimetres with that of square yards, feet, inches, and fractions of inches. Or again, compare the ease with which cubic centimetres can be converted into litres, with the conversion of cubic inches or of fluid ounces into quarts and gallons. Again, compare the conversion of grams into kilograms with that of ounces into pounds, quarters, hundredweights, and tons; or compare the addition of francs and centimes, or of dollars and cents, with that of pounds, shillings, and pence. Little or no allusion was made to this in the lecture, but from a practical point of view it is of great value, and should not be neglected. Sir Frederick seemed to rely a good deal on the fact that in France, notwithstanding the metric system, terms such *demi-kilo*, *tonne*, *sou*, etc., are used in commercial circles; but it appears to us to have little to do with the question. All nations are prone to adopt short names or titles and signs, just as nick-names are used for the names of persons, and we see no disadvantage whatever in their doing so.

THE EXHIBITION OF THE METEOROLOGICAL SOCIETY.—It was hardly to be expected that there would be much that was new at this exhibition, but there were

certainly several objects of interest. Some of the photographs of lightning, for instance, were very good, especially those shown by Mr. Abercromby. The taking of photographs of such a difficult subject is a noteworthy achievement, and one that was not possible a few years ago. The collection lent by the Kew Committee consisted chiefly of apparatus historically interesting, but it included also some of Sir William Thomson's recent electrometers. The section devoted to lightning conductors included specimens of conductors sent to the Lightning Rod Conference, and the model of a church, showing Messrs. Gray and Son's system of continuous copper-band conductors, which are carried round all important projections, then along the ridge, and finally to a main conductor taken down to the ground, with a copper plate at the base. This firm also exhibited models of a house and of a chimney shaft protected by copper bands on the same principle. Messrs. Anderson and Co. also showed models of a church and of a chimney shaft with lightning conductors, and the Postal Telegraph Department sent several examples of lightning protectors for telegraph purposes.

Among the objects damaged by lightning were the tattered remains of the clothing actually torn off a man's body while he was sheltering under a tree during a storm. The clothes were more damaged than the man, doubtless because he was not so good a conductor, especially if his clothes were wet. At the same time the clothes cannot have been good conductors, or they would not have been so torn, and in other instances human beings have been killed while their clothes have not been injured. It would, therefore, be extremely interesting and useful to have a correct explanation of what at present appears to be a somewhat arbitrary selection. Several specimens of damaged conductors were shown, and among them one which terminated in a stable yard, and which had been eaten away by acid.

A section was devoted to "alleged thunderbolts," and it included several useful object lessons for persons given to making hasty conclusions. One well-authenticated "thunderbolt" was really a nodule of sandstone, found at the bottom of a hole made by the lightning. Another was a cannon ball, which from analysis is believed to consist of old Sussex iron; it was found at the bottom of a hole in a manure heap after a flash of lightning had struck near it. In another case the thunderbolt was an unpretending piece of clinker from a boiler furnace. The photographs we have already referred to, but we may add that eight of these were photographic enlargements of drawings of hail-stones, which were extremely interesting, and which we hope to reproduce on a future occasion. There were also photographic views of the new thermograph of the Royal Observatory. If there has been no startling novelty to record, we can at least say that the Society deserves praise for giving the public an opportunity of learning something more than they knew before about some of the great natural phenomena, and the means adopted for their scientific investigation.

THE SUDELEY SYSTEM FOR CHANGE OF GAUGE.

ONE need not be deeply versed in the battle of the gauges to appreciate the fact that when a broad gauge railway waggon reaches a narrow gauge line, or *vice versâ*, there must be a break in the journey, and the goods in the waggon must be transferred. Many suggestions have been made from time to time to get over the difficulty, but so far none have really met the case satisfactorily. We are therefore glad to bring to the notice of our readers a system recently introduced by Lord Sudeley and General Webber, as it appears to us to be at least a step in the right direction. In their patent they limit the application of their invention to the conveyance of broad gauge trucks over narrow gauge railways, but we do not quite understand why the same principle should not be applied to narrow gauge trucks over broad gauge lines. The plan they adopt is simply to have a "transfer waggon" (fig 1), consisting of a frame on bogies, made to suit the narrow gauge line, there being a rail on each side of the transfer waggon at a low level, to receive the broad gauge truck. This will be readily understood by referring to the accompanying illustrations, and it will be seen that when the broad gauge truck is run on to the transfer waggon, as in fig. 2, it can be taken to its destination along the narrow gauge line. The general arrangement is, in fact, not unlike the familiar furniture van when conveyed on a railway truck. At sidings, where the trucks have to be transferred, the end of the narrow gauge line is laid the depth of the transfer waggon lower than the end of the broad gauge line, so that the broad gauge truck may be run on or off the transfer waggon with ease. In special cases where a siding so arranged cannot be provided, an inclined plane is used, as shown in fig. 3, the rails on the transfer waggon being inclined so that the truck to be transferred can be run up or down on to the transfer waggon. It is, of course, essential that the transferred truck should be quickly and securely fastened, and this is effected by chains hooked to the axles of the truck, and attached to a revolving shaft on the transfer waggon. When the chains are hooked the shaft is turned until they are tight, and the position of the shaft is maintained by a ratchet and pawl. The system is being worked out practically by the Lancaster Wagon Company, who have shown us their working model, and we learn from them that approximately the cost of a special transfer waggon is about the same as that of an ordinary goods waggon.

If a trial on a practical scale shows that the system is a

good one, it will admit of narrow gauge branch lines being worked in conjunction with broad gauge trunk lines, without the transhipment of goods or change of trucks. This alone is a very important consideration, as in many country districts the capital outlay necessary for broad gauge branches is prohibitory. With narrow gauges, however, the gradients can be steeper, the curves sharper, and the construction generally can be much cheapened.

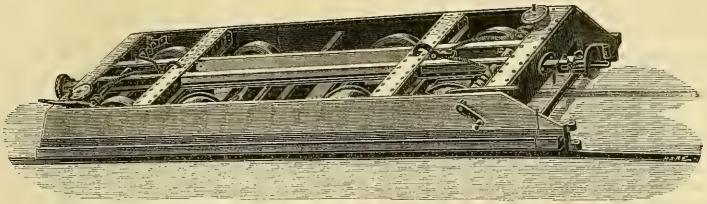


FIG. 1. NARROW GAUGE TRANSFER WAGGON, WITH OUTSIDE RAILS TO RECEIVE BROAD GAUGE TRUCK.

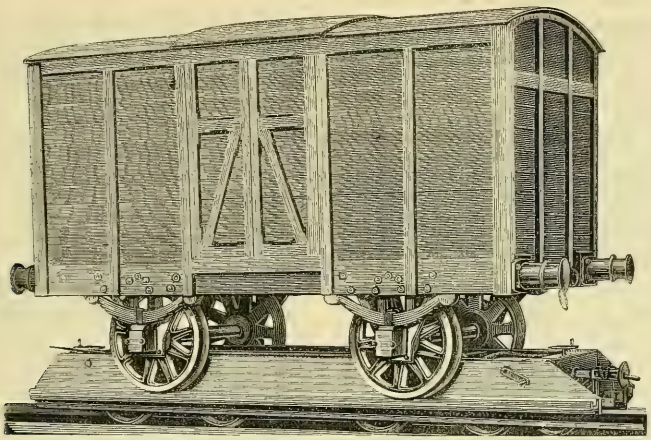


FIG. 2. BROAD GAUGE WAGGON ON NARROW GAUGE TRANSFER WAGGON.

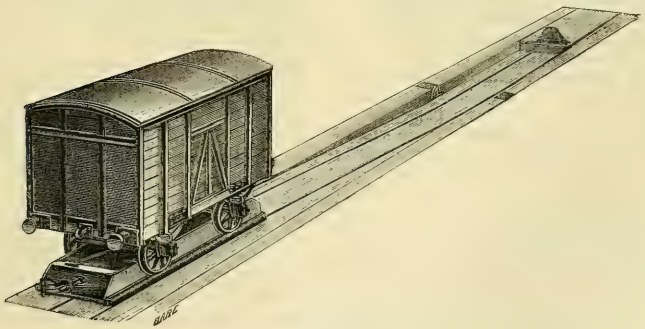


FIG. 3. INCLINED PLANE FOR RUNNING TRUCKS ON TO TRANSFER WAGGON.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Among the humiliating failures of modern science a prominent place must be assigned to the attempts that have been made to determine the temperature of the sun. The problem appears at first glance simple enough. We know the temperature of the solar rays that reach the earth, and we also know that radiant heat, and all other radiant energy, is diffused in suchwise that, like gravitation, it must vary inversely with the square of the distance from the radiating body, and thus, as Sir John Herschel says, "the heat received on a given area exposed at the distance of the earth, and on an equal area at the visible surface of the sun, must be in proportion to the area of the sky occupied by the sun's apparent disc to the whole hemisphere, or as 1 to about 92,000." ("Outlines of Astronomy," section 396.)

The data thus expressed being so definite, we may suppose that if eminent mathematicians have attempted to solve the problem they will nearly agree in their results. The reader who is not already acquainted with these results will, therefore, be surprised by the following figures. Newton's estimate is 1,699,300° Fah. Secchi originally contended for a temperature of about 18,000,000° Fah., and afterwards lowered his estimate to 250,000°. Ericsson puts the figure at 4,000,000° or 5,000,000°. Zollner, Spoerer, and Lane name temperatures ranging from 50,000° to 100,000° Fah., while Pouillet, Vicaire, and Deville have put it as low as between 3,000° and 10,000° Fah. (Young, "The Sun"). Rosetti states the *effective temperature* of the sun to be 18,000. Cailletet says 2,000° C., and Violle 1,400° to 2,500° C. Trowbridge and Hutchings estimate that the temperature of the solar surfaces approximate to that of the voltaic arc. This is based on recent researches, in which the behaviour of carbon at various temperatures in the laboratory is directly compared with that of carbon in certain parts of the sun.

It is, of course, very presumptuous and hazardous for so feeble a mathematical machine as myself to discuss this subject at all, but, in spite of this, I venture to suggest that some of the excessively high temperatures among the above have been obtained by the misuse of those convenient mathematical fictions—the point without dimensions, and the surface without thickness.

In reasoning upon the gravitation of the sun, a planet, or any other mass of matter, it is convenient to assume that the whole mass is situated at one point—its centre of gravity. This, of course, is a fiction, but it leads to no error, provided the reasoner does not assume that any portion of the mass possesses any such gravitating energy, and no one does this. Neither does anyone, in considering the energy of gravitation at the surface of such body (the earth, for example), imagine that such energy is superficial. Everybody knows that the force which brings a body from a height of 16 ft. down to the surface of the earth in a trifle less than a second does not reside merely on the surface of the earth, but is the resultant of the gravitation of the whole of the earth's mass.

Those who reason upon the temperature of the sun by ascribing to his surface an intensity of temperature sufficient to do the work he is known to do, perpetrate a fallacy corresponding to that of assuming that the whole of his enormous gravitating energy is concentrated upon his mere surface.

Everybody knows that a big fire gives out more heat than a little one, and glass blowers, who avail themselves of radiant heat from a limited area (as in the "glory-hole" furnace), know that the radiant energy varies with the depth of the fire measured from front to back, even though its face surface remains the same. The *temperature* of the big fire or deep fire burning in a certain manner is no greater than that of a small fire or hallow fire burning similarly. In chapters 7 and 8 of "The Fuel of the Sun" I have stated in detail the results of my researches on the transparency and diathermancy of flame, which show that flames radiate through each other in suchwise that if one flame is placed behind another equal flame the amount of heat and light radiated from the front of the foremost and the back of the hindmost is twice as great as from either alone, and this without any sensible increase of the temperature or luminosity of either. I carried the experiments up to 17 flames thus arranged, without reaching any well-marked limit to their transparency or diathermancy, *i.e.*, the radiations of all the 16 flames behind passed through the one whose front was presented to the photometer and thermometer, each one adding its share to the sum total of radiant energy, or, otherwise stated, the radiant energy of a flame of given temperature and brilliancy varied with its thickness, so far as my experiments went. Whether this would still be maintained if a thousand flames were radiating through each other, or a mass of flame of thickness measurable in miles, I cannot affirm; but the experiment justified the conclusion that all the known effects of solar radiation, both thermal and luminous, may be produced by a flaming envelope (the photosphere) having a temperature corresponding to that of our ordinary gas-flames burning under similar conditions of pressure, provided the depth or thickness of such flaming envelope is sufficiently great.

We all know that a paraffin lamp with a duplex wick gives more light than with a single wick, although the outside broad radiating surfaces of the flame are equal in both cases. In the "Lucigen" and the "Doty" lamp this principle is carried still further. Here we have a huge flame 3 ft. or 4 ft. long and a foot or more in thickness, but with an intrinsic or specific luminosity decidedly below that of an ordinary paraffin lamp. These large flames are used for lighting large out-of-door spaces, as substitutes for daylight, where large numbers of workmen are employed at night time. *Iron*, of March 16th, tells us that a newspaper was read at 135 ft. from a Doty Light, at Deptford. I find it difficult to do this at 13½ ft. from my study lamp. Applying the law of inverse squares, as it has been applied by some in measuring solar temperature and luminosity, we should conclude that the flame of the Doty lamp is 100 times more brilliant and 100 times hotter (its thermic radiations correspond with the luminous) than an ordinary lamp, which is absurd. *Quantity* of energy, as well as intensity of action, has to be considered. We can no more determine the temperature or luminosity of the solar surface by its distant radiant results, than we could predicate the velocity of a moving body by only knowing its momentum, or *vis viva*, without also knowing its mass.

Superannuation of Professors.—It is proposed at Paris to fix sixty-five as the age of superannuation for all future professors, seventy being allowed for those holding chairs at present.

ARTIFICIAL RUBIES.

THE ruby, the corundum of mineralogists is, from a chemical point of view, simply crystallised alumina. Hence, to obtain rubies, we have to crystallise alumina, but this is a problem much more difficult than it may seem at first sight. Several chemists, such as Gandin, Ebelmen, H. Deville, Caron, Debray, and some others, have previously obtained corundum, but merely in the form of a powder.

In 1877 MM. Frémy and Feil succeeded in producing small crystalline rubies. In 1877 M. Frémy resumed his experiments in concert with a young chemist named Verneuil, and he soon effected great improvements in the process of crystallising alumina.

On February 27th last, MM. Frémy and Verneuil, after further experiments, submitted to the Academy of Sciences rubies in rhombohedric crystals, obtained in a regular manner by the action of certain fluorides upon alumina.

Their method consists in causing fluorides, and especially barium fluoride, to react at a red heat upon alumina containing traces of potassium bichromate, which supplies the colouring matter. The regularity of crystallisation, attained after many trials, is especially due to the regulation of the fire, which determines and modifies the chemical reaction.

These crystals are very different from the specimens exhibited in 1877. The latter were thin, laminar, and friable, and had been formed in a vitreous gangue, which rendered their purification almost impossible. Thus, on analysis, their composition was not constant. In the recent experiments the crystals are formed, not in a vitreous mass, but in a porous and friable gangue, where they line the interior of geodes. It is curious, on breaking up this mass, to see the rubies, with their beautiful rose-red colour, appearing among the white material in which they have been formed.

M. Des Cloizeaux, the eminent crystallographer, has examined these artificial rubies, and declares that they display exactly the form of the natural jewels.

The separation of the rubies from the gangue presents no difficulty. It is sufficient to drop the product of the calcination into a bottle of water, and shake it briskly. The gangue remains in suspension in the water, whilst the rubies, being heavier, sink to the bottom, and need no treatment with acids. Their crystalline form is regular, their lustre is adamantine, their colour beautiful, and their transparence perfect. They have the hardness of the natural stone, and easily scratch the topaz. Like natural rubies, they turn black on heating, and resume their red colour on cooling.

The accompanying illustrations, from our contemporary, *La Nature*, show the forms of these rubies.

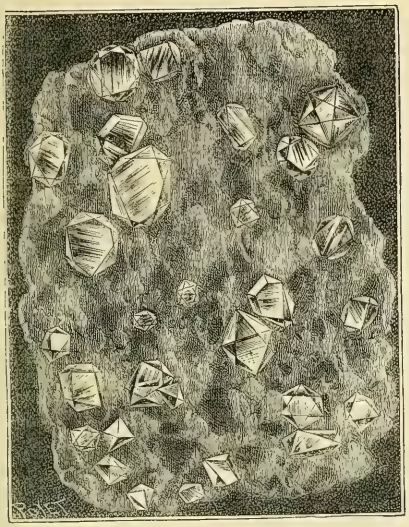


FIG. 1.—ARTIFICIAL RUBIES IN THEIR GANGUE. MAGNIFIED TWENTY DIAMETERS.

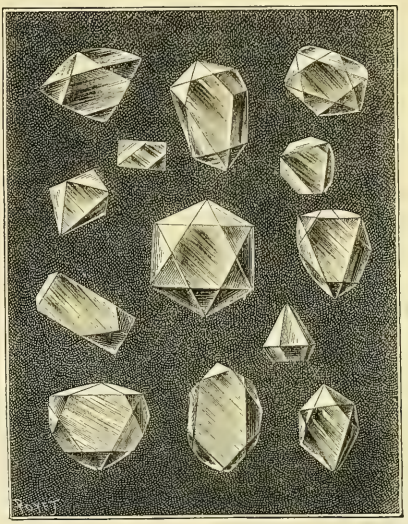


FIG. 2.—CRYSTALLINE FORMS OF ARTIFICIAL RUBIES. MAGNIFIED THIRTY-FIVE DIAMETERS.

ACCLIMATISATION.—I.

WE often hear of the *Société d'Acclimatisation*, of Paris, and of its gardens, which contain now a more interesting collection of animals than does the time-honoured Jardin des Plantes.

In these gardens a number of very important experiments in hybridisation and in the education of animals have been performed. But the original object of the Society was simply to introduce into France animals which were natives of other and different climates. Thus the inelegant word acclimatisation has in common

practice come to have a very different meaning from that which its etymology would show. As generally used it means the introduction of any alien plant or animal into a country by human agency. Whether such immigrants had to be gradually adapted to their new home by a series of physiological modifications, or whether they at once found it equally congenial with their mother country, or perhaps even more so, is not here the question.

Another glance at the word may still be useful. It seems to imply that the main reason why any animal or plant flourishes in one country but perishes in another is some difference in the *climate*, in the ordinary geographical sense of that word. That is, it conveys the impression that the fauna and flora of a country depend solely upon its mean or its extreme temperature at different seasons or for the entire year, upon its degree or distribution of moisture, or upon atmospheric pressure. Now without overlooking the influence of these physical conditions of life we must remember that they are not the sole agencies in determining what species shall live in any given region. There are good physical reasons why humming-birds are not found in Iceland, Greenland, or Siberia. There are no such reasons manifest why they might not flourish in Madagascar, in Borneo, or New Guinea, as well as in Guatemala or Brazil.

It was said above "the introduction of a living species through human agency." We might have added "intentional or accidental." It will not be supposed that man has knowingly and of set purpose selected as his companions those living beings which have accompanied him in his wanderings. Far from it: as proof to the contrary we need merely mention the cockroach and the grey rat, —Norwegian of earlier writers, Hanoverian of Charles Waterton, but more truthfully and more significantly Russian! Man would no more wilfully acclimatise such pests than he would the small-pox or the cholera.

It is often thought that acclimatisation is promoted and recommended by scientific men. Such is by no means the case. The genuine zoologist or botanist looks upon the introduction of alien species in a feral state into any country with as little approval as the classical scholar regards the interpolation of spurious passages in some ancient author. Even in Britain doubts have already arisen whether certain plants are truly native or whether they have been artificially introduced. That the consequences of the artificial immigration of plants and animals may teach us valuable biological lessons is admitted. But none of us would have made the experiment. No scientific man, from the highest to the lowest, would have carried goats to St. Helena or the Cape, rabbits to Australia, or white cabbage-butterflies to America merely to see what would happen.

We must remember that acclimatisation is a very serious thing; far too grave to be left to the indiscretion of ignorant and careless individuals. Even the extirpation of existing forms of animal and plant-life is a task which ought not to be undertaken with a light heart and without well counting the cost. But the risk in introducing some alien species is tenfold graver; the step if once taken may prove, as far as man's present resources are concerned, beyond recall, and the consequences cannot be in the least foreseen. Of this we shall find some warning examples.

Perhaps the first lesson to be learnt from our present experience in acclimatisation is the baselessness of one of the dogmas of the Old School of Natural History. It was formerly taught that the plants and the animals of any given country were especially adapted to the soil, the climate, and all other conditions of that locality. It was believed that if transplanted to any other country they would be less prosperous than in their original home, whilst conversely, species brought from elsewhere would maintain their ground with difficulty if at all.

There are, indeed, many cases where plants and animals, the former more especially, seem limited to their original locality. Thus the durrian and the mangosteen of the Malay Islands do not succeed well even in Ceylon and on the mainland of India, and utterly fail in the West Indies. The shaddocks of the Azores and the Antilles are "flavourless as turnips if compared with those of Bangkok or Labuan."

But there are no less signal instances to the contrary. The thistle madly brought from Scotland to Australia grows there with a fell luxuriance quite unknown in its native soil. Even the sweet-brier, which is nowhere exceedingly common or rampant in Britain, is becoming in New South Wales a serious nuisance, which the farmer and the gardener are obliged actively to combat.

Nor are these exceptional cases even among plants. With animals the case is even more striking. The rat multiplies in every corner of the globe where it has penetrated no less readily than in its original home on the Volga. The rabbit, criminally turned loose in Australia, has proved itself an unlimited curse. The sparrow, acclimatised in the United States, in Australia, and in New Zealand, contrary to the advice of judicious European naturalists, has not only established itself but is seriously interfering with the native bird-population. It is certain that the cockroach or "black-beetle" of unscientific insect-lore is not indigenous in Britain. It is equally certain that its extirpation is one of the most unlikely events conceivable. Blood-sucking gnats, according to Baron Osten-Sacken, were only introduced into the Sandwich Islands about 1828 to 1830: they have since spread and are becoming a serious nuisance. The same eminent authority states (*Trans. Entom. Soc. of London*, 1884, p. 492) that the two-winged insects popularly "lumped" together as house-flies "have been imported into Chili, Australia, and New Zealand, where they were not indigenous," and where, it may be added, they are multiplying and growing truly formidable. The United States, even, seem to have been originally free from this plague. Hence it may be safely said that the aboriginal plants and animals of any country are by no means necessarily confined to that country, but that when intentionally transported elsewhere they may flourish as well as, perhaps even better than, at home.

(To be continued.)

GUM ARABIC.—A substitute for this substance, patented in Germany, is made as follows:—Twenty parts of powdered sugar are boiled with 7 parts of fresh milk, and this is then mixed with 50 parts of a 36 per cent. solution of silicate of sodium, the mixture being then cooled to 122° Fahr. and poured into tin boxes, where granular masses will gradually separate out, which look very much like pieces of gum arabic. This artificial gum copiously and instantly reduces Fehling's solution, so that if mixed with powdered gum arabic as an adulterant, its presence could be easily detected. The presence of silicate of sodium in the ash would also confirm the presence of adulteration.

General Notes.

GREAT COLLECTION OF COLEOPTERA.—The great collection formed by Dr. Victor Plason and his brother, at Vienna, comprising 60,000 species in about 500,000 specimens, has been purchased by Dr. Richter, of Berlin.

A PARASITE OF THE VACCINE MATTER.—According to M.P. Pourquier (*Comptes Rendus*) vaccine matter, amongst other causes of degeneration, is liable to the attacks of a parasitical micro-organism. This invader is perfectly distinct in its microscopical characters from the micrococci of septicemia and pyaemia.

THE WINTER IN AMERICA.—It is recorded that in America the winter has been more exceptionally severe than in Europe, not merely in Canada and the northern States, but as far to the south as Texas. In Nebraska and Kansas the temperature is said to have fallen within twenty-four hours from 73° Fahr. (?) to 27° below zero, or 59° of frost.

THE EXTIRPATION OF RABBITS.—M. Mégnin (*Cosmos*) suggests that instead of combatting these vermin by means of "chicken cholera," the possible evil results of which he exaggerates, means should be taken to introduce among them hepatic phthisis, a malady peculiar to rabbits, or at least to rodents. This disease is as surely though less rapidly fatal.

COLLECTION OF LEPIDOPTERA.—According to *Humboldt*, the collection of Lepidoptera belonging to the late portrait-painter, Max Mutzell, of Berlin, has been sold to a private purchaser for £950. This collection is especially rich in series, showing the local and seasonal variations of different species. Hence its having passed into private hands is no small loss to science.

SUPERSTITIONS CONCERNING VACCINATION.—The country people in France think that this operation should be performed only in May, but never on a Friday, and that the subject should never be less than five months old. *La Science en Famille* mentions also the belief that if a girl is vaccinated from a boy, she will acquire unfeminine ideas and tastes.

NEW ARMOUR-PLATING FOR SHIPS.—According to *La France* a new vessel, the *Dupuy-de-Lôme*, about to be constructed at Brest, will be plated not with steel or aluminium bronze, but with an elastic material known as amorpho-cellulose, and which seems to be a compound of caoutchouc. It is asserted that if this substance is pierced by a projectile the hole either closes up or contracts to such a degree that the inrush of water is trifling.

DESTRUCTION OF RABBITS.—At the session of the Paris Academy of Sciences, February 27th, M. Bobierre demanded the opening of a "sealed paper" which contains a proposal to destroy rabbits by introducing into their burrows deleterious gases, such as carbonic oxide, the vapour of carbon disulphide, and especially carbonic acid. This method is evidently much more cumbrous in execution, and less far-reaching in its effects than that of M. Pasteur.

THE DEPOSIT OF ICELAND SPAR.—According to M. Labonne, the mine of Iceland spar is by no means exhausted. It is situate on the north side of the Esquifjörd, at the elevation of 95 metres above the sea-level. Limpid crystals, fit for optical use, are disseminated throughout a mass of modified basalt. The deposit has been leased to Carl Tulinius, an Iceland merchant, who sells from time to time the detached spar, without undertaking any systematic working.

THE UTILISATION OF MOORS.—In some of the provinces in Holland exist large tracts of heath and moorland which at present are of little value, although once covered with dense forests. An effort is now being made to form a company, whose object it will be to attempt a gradual fertilisation of the soil by re-planting trees. How much good such an enterprise can work under careful management is shown by a similar undertaking in Denmark, which has started some four hundred plantations in different parts of Denmark.

SEWAGE DISPOSAL.—M. Defosse, of Brussels, has invented a new system of purifying sewage and the waste water of factories. The process consists of three stages. In the first, the solid matter is precipitated in settling tanks. The second stage consists of filtration through a bed of turf, specially prepared, and capable of being cleaned and used over again for an indefinite number of times, finally the product is passed over a bed of spongy iron. The purified water passes away to the river through a channel containing broken limestone.

A CHINESE ANÆSTHETIC.—A curious anæsthetic used by the Chinese has recently been made known by Lambuth in his third annual report of the Soochow Hospital. It is obtained by placing a frog in a jar of flour and irritating it by prodding it. Under these circumstances it exudes a liquid which forms a paste with a portion of the flour. This paste, dissolved in water, was found to possess well-marked anæsthetic properties. After the finger had been immersed in the liquid for a few minutes it could be pricked with a needle without any pain being felt, and numbness of the lips and tongue was produced by applying the liquid to them.

ALUMINIUM BRONZE.—At a series of comparative tests of common and aluminium bronze at the Watertown Arsenal, New York, the results were as follows: Ordinary bronze showed a tensile strength of 24,500 lb. per square inch, with an elongation of 8·2 per cent. Aluminium bronze, known commercially as "A 3," cast in sand, showed a tensile strength of 53,000 lb., and an elongation of 6·2 per cent., while the same metal cast in chilled moulds resisted a strain of 67,600 lb. to the square inch, with an elongation of 13 per cent. In the opinion of naval experts it is thought that steel and wrought iron will be displaced to a considerable extent by this metal. —*Industries*.

DANGERS OF RAIN-WATER.—The rain-water collected from the roofs has been recommended after filtration for a domestic water-supply. Now, if we leave out of account the possible atmospheric pollution, the roofs of

houses are often the gathering-place of pigeons. As these birds are liable to diphtheria, and have been reported as communicating it to man, the drainage from roofs should be avoided. An instance is given of a household in Naples where four out of five children died of diphtheria. The flat roof was the abode of hens, turkeys, and pigeons, and the servant had been duly cautioned against drawing this water for drinking or cooking. To save trouble she neglected this charge, and the result was as already mentioned.

THE NATURAL GAS WORKS OF PITTSBURG.—As some of the wells owned by the Wheeling Natural Gas Company, of Pittsburg, gave signs of a decrease in the supply obtained from them, this company determined, says *Engineering*, to try if a fresh supply could be obtained by carrying the borings to a greater depth. Operations were, therefore, commenced on one of their wells, having a depth of about 2,100 feet. On carrying the boring down an additional 200 feet a new gas-bearing stratum was discovered. The gas blew out at a pressure of 600 lb. per square inch, and prevented all attempts at further drilling. Three or four other wells have since been similarly treated, and in each case with satisfactory results, the supply of gas being nearly double the former output. It would thus appear that a supply of gas can be relied on for many years to come, and the Pittsburg manufacturers are consequently jubilant.

A SUNKEN FOREST.—It is said by fishermen who ply their vocation off Kenosha, Wis., that a forest of considerable dimensions exists in the bottom of Lake Michigan. Some years ago it was the custom with the fishermen to cast their nets nearer shore, but as the fish gradually became less plentiful the fishermen moved farther out, until they encountered the forest of trees mentioned, and it effectually prevented them from using their nets there. Repeated experiments fixed the farther boundary line of the timber something near twenty miles from shore, to which distance they now go to cast their nets. It is stated that trees have been known to wash ashore that have evidence of having remained under water for centuries. They were in a perfect state of preservation at first, but they soon decayed after exposure to the atmosphere. The wood, too, was of a kind entirely unknown in this country or anywhere on the lake.

PERMANENCE OF THE CLIMATE OF EUROPE.—M. J. C. Houzeau gives in *Ciel et Terre* a novel and very striking proof that the climate of the west of Europe cannot have undergone any great change for some centuries. It is well known that formerly in France the time of beginning the vintage was not left to individual discretion. The mayor of each commune fixed the time according to the advice of experts. The communal registers have preserved the dates of these official proclamations, extending back in some localities to the fourteenth century. The dates of the vintages at any given place are found to have varied considerably from year to year, sometimes as much as seventy days. But if we take the mean epoch for any place, by periods of thirty, forty, or fifty years, we find that there has been no progressive variation. In other words, the climate of France, as manifested in the development of the vine, has neither improved nor deteriorated since the fourteenth or fifteenth century. M. Houzeau mentions that the olive-tree perishes if exposed for a single night to a temperature of 24½ Fahr. (= 7½ degrees of frost).

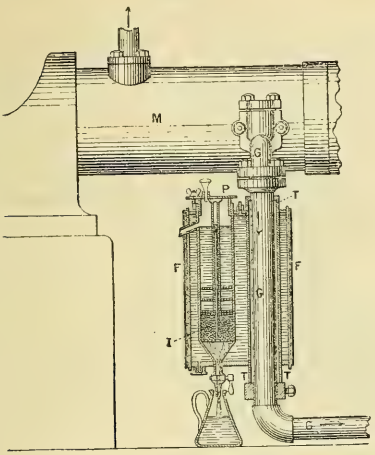
SUPERSTITIONS CONCERNING COMETS.—A contemporary gives the following summary of the light in which comets were regarded down nearly to the middle of the present century:—They were supposed capable of all sorts of mischief, from turning a pail of milk sour to setting the earth on fire. If Gaffer's apples withered on the trees, it was all the fault of the comet; if Gammer's goose went lame, the same explanation was enough. Pestilence and famine were among the recognised satellites of the brilliant vagabond, and Emperors and armies have been terrified by its appearance. The Plague of London was due to the comet of the year, and in 1668 the appearance of one of these meteors occasioned a remarkable epidemic among cats in Westphalia. In 1746 Lima was overthrown by an earthquake, which was the result, of course, of the comet that was then in the sky; and the same cause led also to the occurrence of unusually large flights of pigeons in North America, and to the prevalence of the "sneezing sickness," as it was called in Germany. So, at any rate, it was said at the time. Even much later the apparition of one of these nebulous luminosities led to important results, for in 1811 the port and claret vintages were exceptionally excellent; on the other hand the number of twins born was unprecedented; a shoemaker's wife in Whitechapel gave birth to four children; there were no wasps in the autumn; and flies were all blind that year. All this and much more was, seventy-four years ago, gravely attributed to "the comet."

LEPET OR "PICKLED TEA."—In a communication to the *Indian Forester* the writer, who recently ascended the Chindwin river in Upper Burmah, describes a village called Kawya, on the river, where the people are wholly devoted to the cultivation of tea, and which may be considered as the southern limit of the tea plant in this region. Before planting, the ground is cleared of all undergrowth, but high trees, even those of the densest foliage, are left standing. The seedlings, which are usually raised indoors, are planted out in rows at the beginning of the rains, and the first pickings take place when the plant is three or four years old. When it grows too large it is cut down, and three or four new stems shoot out from the stool. The leaves are plucked and immediately steeped in boiling water for a short time; they are then taken out, strained, thoroughly kneaded with the hands, and pressed into bamboo baskets, when they are ready for market, and fetch locally four rupees per 100 lb. This "pickled tea," as it is called by Europeans, *lepet* being the Burmese name, is floated down the river in baskets or hollow bamboos, which are carefully kept below the surface of the water to preserve the quality of their contents. *Lepet* is a favourite among the Burmese, who mix salt, sesamum oil, and other ingredients with it. To the ordinary European its taste is as bad as its smell, which is saying a good deal. The soil along the Chindwin is eminently suitable for tea cultivation; the plant grows wild on all the hills and attains enormous dimensions. One tree which was found neglected in a corner measured 18 inches in girth at one foot from the ground, and was fully 20 feet high.

FILTER FOR LUBRICATING OILS.

IN consequence of the greater heat developed by gas and petroleum engines, compared with steam engines, the former require a liberal allowance of oil to lubricate the piston and slide-valves. It is, moreover, especially important that the lubrication should be constant and automatic, as engines of this type are so often left working without the presence of an attendant. A considerable quantity of oil drips from the working parts of the engine, and this is usually collected in tins or pans, but in the state in which it leaves the engine it is too dirty to be used again for purposes of lubrication.

According to *La Nature*, Mr. E. Ducretet has devised an oil-filtering apparatus, which he attaches to the engine, as shown in the accompanying illustration. M is the cylinder of the engine, and G the exhaust-pipe, through which the hot products of combustion escape. Around the pipe G is fixed an outer pipe T, which passes through a tank F containing oil to be filtered. The



filter proper I is also placed in the oil tank F, and the action is as follows: the pipe T becomes heated by the hot exhaust-pipe G, and so communicates heat to the oil in the tank F. As the oil expands with heat it is forced through the filter I, and then it runs off into a can at the bottom.

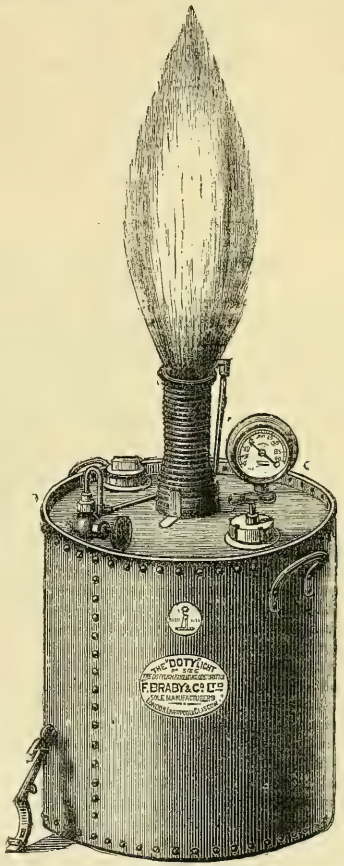
The arrangement appears to be simple, and little likely to get out of order, provided the pipe T is not allowed to become hot enough to burn or vapourise the oil, which it certainly would do with the larger sized engines if it were too close to the exhaust pipe, G.

In the course of his experiments, Mr. Ducretet has found that mineral oils are the best, if of good quality. They are the cheapest, they do not oxidise the metal, they are not readily decomposed, and when filtered they can be used over and over again.

A RICH UNIVERSITY.—The University of Leyden is said to be the wealthiest in the world. Its real estate is valued at about £800,000.

THE DOTY LAMP.

THE lamp shown in the accompanying illustration is intended for out-of-door use for such purposes as the lighting of engineering and shipbuilding yards, of railway goods yards, docks, contractors' works, etc. It is, in fact, a rival of the "Lucigen" lamp, which was fully described at the Society of Arts in December last. The apparatus consists of an iron cylinder or drum



which contains a supply of fourteen to twenty gallons of mineral oil, according to the size of the lamp. On the top of the drum is a coil of pipe, one end of which dips into the oil in the drum, and the other end terminates in the middle of the coil and acts as a burner. A small air-pump is fitted to the drum for the purpose of applying pressure to the oil, so as to drive it through the coil.

The first operation is to pump in air above the surface of the oil until there is a pressure of 10 to 15 lbs. per square inch. The coil is then heated by burning round it a little cotton waste or other inflammable

material. The object of heating the coil is to vapourise the oil which passes through it, and as soon as the vapour issues from the end of the coil it is lighted, and then there is a very powerful light. The flame heats the coil, so that after the first heating with cotton waste, etc., the whole operation is automatic so long as a sufficient working pressure is maintained in the drum. We understand that the air pump has to be worked about every two and a half hours, and that with a 500 candle-power light the charge of oil will last about thirteen hours. The oil consumed for a lamp of this power is said to cost only sixpence per hour.

Lamps of this kind are not only powerful, but portable, and as the cost of the oil used is moderate, it is probable that they will be used extensively. The inventor of the lamp we are now describing is Captain Doty, who is well known in connection with the introduction of mineral oils for lighthouse illumination. The makers are Messrs. Braby and Co., of 362, Euston-road, London.

SOCIAL ANIMALS.

AMONG the very lowest animals society begins by actual physical fusion, accompanied very soon by physiological division of labour. In societies of the highest animals there is no physical differentiation, except such as depends upon age or sex, and the bond of cohesion concerns the instincts only. A middle term is furnished by the social insects, where the physical differentiation is sufficiently strong to produce at least a third (the so-called neuter) sex, while the instincts are at the same time powerfully affected, so that self-sacrifice to the extent of death or mutilation in the common cause is felt as a less evil than infringement of the cardinal social rules.

In rude societies, whether of men or of animals, the first necessity is cohesion. Right or wrong, the voice of the community, or the royal word of command, must be obeyed and enforced. The bee exercises no right of private judgment in the presence of the swarm. When the queen flies to a bough the workers fly there too. If she flies down a cottage chimney or into the deadly fumes of a lime-kiln, the workers are bound to keep her company. Where the train of ants goes every one must follow, and they will face fire and water rather than desert the track. Bees and ants illustrate the best, because, in the simplest way, the prime essentials of the social state. In them virtues profitable to the community are generated by social conditions and adaptation thereto, without abstract reasoning or reflection. The laws of conduct which govern the hive or ant-hill are based upon long experience of utility, but they are obeyed with exemplary indifference to the immediate happiness or misery of the individual.

It is for the naturalist to point out how eminently successful this policy has proved in a world of selfish competition. Bees, wasps, and ants—that is the peculiarly social insects—are almost world-wide in their range. They are also extremely numerous in species, and in all other respects must be counted as conspicuously dominant forms. Their success as a competing form is evinced by the number of plausible imitations which they have called forth. There are Diptera, Hemiptera, and Lepidoptera, which assume the black and yellow rings, while certain of the Lepidoptera have even changed their plumed wings for nearly clear ones, in order more closely to resemble the wasp, or hornet, or bee. Ants again are mimicked by spiders. No doubt these base imitators escape attack by their resemblance to creatures which have stings or formidable jaws, and which are instructed by a long established social instinct when and how to use them with effect. In other cases the mimicking forms use their deceptive exterior to escape detection when making their way to the stores of food laid up by the colonies. Perhaps the gnats and mosquitos, whose social relations are rudimentary, may even exceed in numbers the truly social hymenoptera and orthoptera, but they get far less enjoyment out of life. The finest fields of industry open to insects are occupied by the well-organised societies. In a world where competition rules supreme, it is the social tribes which come to the top.

STORMS.—IV.

(*Concluded from page* 244.)

THE following are the sailing instructions recommended by the U. S. Hydrographic Office, referred to in connection with fig. 5, and we regret that by an oversight they were omitted in our previous number:—

With an east wind, changing to southward, heave to on the starboard tack.

With an east wind, changing to northward, run west north-west or heave to on the port tack.

With an east south-east wind, changing to southward, heave to on the starboard tack.

With an east south-east wind, changing to eastward, run to the north-west or heave to on the port tack.

With a south-easterly wind, changing to southward, heave to on the starboard tack.

With a south-easterly wind, changing to eastward, run north north-west or heave to on the port tack.

With a south south-easterly wind, changing to southward, heave to on the starboard tack.

With a south south-easterly wind, changing to eastward, run north or heave to on the port tack, and so on round the compass.

The above courses are for the wind two points on the starboard quarter; but, if sea and wind permit, bring the wind broad on the quarter. If in either of these positions there be danger of broaching to, run before the wind until more moderate, and then bring wind on starboard quarter.

A ship having the wind steady is on the storm-track, and should run before the wind; note the course and keep it.

THE COLOUR OF THE EYES.—M. de Candolle, a French investigator, has come to the conclusion from his researches that women have a larger proportion of brown eyes than men. He also finds that when both parents have eyes of the like colour, the chances are 88 to 12 that their children who arrive at the age of ten years (when the colour of the eyes is fixed) will have eyes of the same colour. When the parents have eyes of different colours the chances are 55 to 45 in favour of brown as against blue or grey eyes in the children. He is also of opinion that the health of the brunette type is, as a rule, superior to that of the blonde type.

Natural History.

EDIBLE ANTS: A NEW CHAPTER IN COOKERY.

Not long ago an enthusiast, or possibly a "joker of jokes," wrote a book in which he recommended insects as an article of human diet. Now, leaving out of consideration the feelings of disgust and horror which such a proposal called up in the mind of John Bull, and especially of his better half, we must remind our readers that not a few insects secrete formidable poisons. Thus, insect-eating is an experiment which should not be tried "with a light heart." Still it must be admitted that certain savage tribes in central Africa, the Malay Islands, and Australia, vary their diet from time to time with a dish of caterpillars. In many tropical regions the "white ant"—which is not an ant at all, but belongs to a totally different order—is eaten with relish, not merely by the natives, but by European residents, and is said to taste like sugar and cream, or, according to other authorities, like sweetened almond-paste.

But it is not generally known that in the province of San Paulo, in Brazil, a large species of true ant is a recognised article of food.

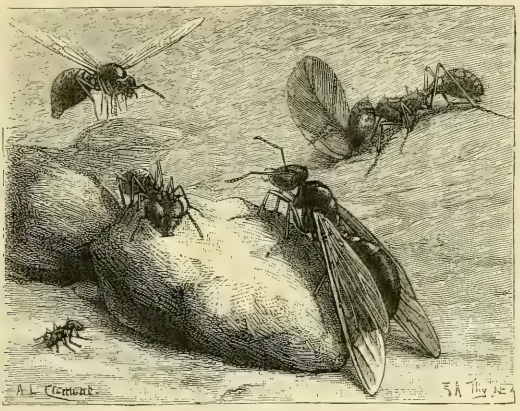
These ants, called in the Brazilian Portuguese tongue *Formigas Tanajuras*, when in season, are roasted, like chestnuts, until they are of a nice brown colour, and are then hawked about the streets by women, who cry *va ica*, which means "something to eat," and are eagerly bought up.

By way of attracting notice, the dealers dress up some of these ants like dolls.

The eatable ants of Brazil belong to the species *Atta cephalotes*. The large winged specimen, in our illustration borrowed from *La Nature*, is the female; the one represented in the act of flight is the male, which is considerably smaller. The neuters, or working ants, which are wingless, are found in two forms, differing very greatly in size, as will be seen on comparing the small figure at the left-hand bottom corner of the cut, with the much larger ant at the upper, right-hand corner. It is a problem of no little difficulty to explain how or why these two different forms should occur, so to speak, promiscuously in one and the same brood. The season of the year and the age of the parents do not seem to have in this respect any influence.

This ant, like too many others, commits grievous ravages in the plantations, so that its employment for food is a kind of compensation, though very far from being adequate. It is a *leaf-cutter*: that is, swarms of this ant climb up a tree and cut off pieces of leaves about the size a sixpence. These are then carried off to the nest. The long procession of ants, each carrying a segment of a leaf, has a most singular appearance. To a hasty observer it might seem as if the leaves were in spontaneous motion. Unfortunately they attack, in preference, the most useful trees, such as the coffee and the orange.

A coffee plantation has been known to be completely stripped of its leaves in a single night, the result being the loss of the year's crops. Where such inroads are often repeated or continual, the trees are destroyed outright. Our late lamented friend, Thomas Belt, then residing in Nicaragua, combated them successfully with carbolic acid and with corrosive sublimate.



EDIBLE ANTS.

To what use the ants put these leaves, which they collect so diligently, is still a matter of dispute. Belt suggested that they formed in the nests a kind of hot-bed upon which grow certain small fungi used by the ants as food. That the fungus actually grows in the underground chambers of the nest is certain, and that the degree of moisture and the temperature of these cellars is carefully watched over is no less established; but it has not yet been proved that the ants actually eat the fungus.

Dr. McCook, on the other hand, a great authority on ant-life, contends that the leaves, by fermentation, are converted into a greyish or brownish paper-like matter, which the ants employ in the construction of hexagonal cells resembling those of bees and wasps, but less regular.

It must be remembered that several distinct species of

ants practice leaf-cutting, and that they inhabit various regions from the south of Brazil to Central America, to Mexico, and even to New Jersey.

The nests of the eatable ants are in some parts very numerous: they form hillocks of about one-and-a-half yards in width at the base, and perhaps two feet in height.

In speaking of food insects, we should not omit to notice the common locust, which is often consumed by the Arabs. These insects, after being stripped of their wings, are sometimes preserved in oil, like sardines. A French officer, who had recently the opportunity of tasting this strange delicacy, reports that it might possibly be not bad eating if only the oil were not rancid and if there had been a less liberal admixture of sand.

Plants Destructive of Germ Life.—A correspondent of the *Agricultural Gazette*, writing with reference to the influence of certain vegetable products on bacteria and other forms of "invisible life," gives a list of plants which are reputed as being inimical to the development of germ life. These include *Bridelia spinosa*, *Soulamea amara*, *Herpestis amara*, *Teucrium Africanum*, *Cyperus rotundus*, Peppermint, *Andrographis paniculata*, *Acacia orfola*, *Pinus sylvestris*, Scotch fir, and Larch fir. We are told that the bark and leaves of the former, which can be got from various parts of the Indian empire, where it grows, is eaten by the native cattle when infested with animal or vegetable parasites, and proves an effective remedy. *Soluamea amara* is also an East Indian plant. In the Malayan archipelago it is reported by Dr. Lindley as successfully used in cases of cholera and pleurisy, etc. It is likewise used in pneumonia. In the Molucca Islands *Herpestris amara* is greatly esteemed as a preventive of the growth of animal and vegetable parasites. *Teucrium Africanum*, as the name implies, is a native of Africa, where it is reported to kill bacteria in anthrax in cattle and glanders in horses. Cattle that die of anthrax are eaten by the Kaffirs along with this plant, which prevents their being infected. Of the others, *Cyperus rotundis* is said to be used with favourable results in cholera; *Andrographis paniculata* in cholera, dysentery, and intermittent fevers; and *Acacia orfola* in preventing camels' milk from becoming sour for a considerable time. Scotch and Larch fir barks are said to prevent anthrax, and it is thought probable that all the pine and fir bark juices possess similar properties. Scientific writers, we are told, such as Linnæus, Withering, and Somerville, drew attention to the fact that non-coagulation was due to milch cows eating peppermint. It is now a well-established fact that when much of it is eaten the taste in the milk is perceptible, and that it prevents coagulation even when the quantity eaten is so small as hardly to be tasted in the milk. It has long been known to farmers and dairymen that if milch cows eat peppermint in their pastures or hay, their milk will not make cheese. In the olden times this was attributed to witchcraft. But since it was discovered, by Koch and other microscopists, that the coagulation of milk is due to the rapid growth of a thread-bacteria and other germs in the rennet, farmers and dairymen have got a scientific solution of the problem, viz., that these micro-germs cannot be grown when the preventive properties of peppermint are present in milk, although only infinitesimally small in degree.

A Step in Pisciculture.—In the systematic propagation of food fishes the great difficulty has been the supply of proper nutriment for the young fry. It is well known that the larvæ of gnats, entomastraca and other forms of minute aquatic life constitute the natural diet of fish in their so-called "alevin" stage. Fish-cultivators have, when possible, selected waters where such creatures are plentiful, or have attempted to collect them. But M. Lugrin has discovered a simple and inexpensive way of propagating them in any required quantity. "In a fortnight any pond through which a stream flows may be so stocked with natural food as to be able to sustain the young fish until they are one month old, and similar cultivation can be continued until they are at least one year old and suitable for being turned out. If afterwards natural food is deficient in certain waters or at certain times, it can always be supplied by cultivation. This method has been tried with full success at Grenaz, near Geneva, and is about to be introduced at Haslemere.

Extirpation of Rats.—According to *L'Union Medicale*, it is easy to communicate tubercular disease to rats and mice. This observation shows the possibility of dispensing with cats and terriers, both of them animals open to grave objections.

Polynuclear Infusoria.—Gruber describes in the *Berichte der Naturforschenden Gesellschaft in Freiburg* a number of marine infusoria, partly new, in part formerly known, in which there are a great many nuclei. The division of the nuclear substance is carried so far in some that even under the strongest magnifying powers the nuclei appear only as minute granules. As these bodies prove all to be true infusorial nuclei, they must all have their meta-nuclei, but our magnifying powers are not sufficient for their detection. Still they are present, as is shown by the process of separation in *Holosticha scutellum*. As soon as the multiplication begins all the nuclei coalesce to a central mass, and the meta-nuclei do the same. When thus aggregated they are visible to the eye as a small body, situate near the main nucleus. The mass of both kinds of nuclei, accurately divided in halves, is then transferred to the two daughter-specimens into which the original individual is being resolved. But even before this fission takes place the main nucleus has again split itself up into numerous nuclei, and the meta-nucleus is often separated to such a degree as to be no longer visible with the microscope. These observations are of value, since they afford us tangible proof of the extended divisibility of living matter, and especially of that matter which is the main seat of life—idioplasm. We see it here pass from a visible body by successive halvings into invisibility, and yet we know that it is present.

Introduction of Fishes into Chili.—We learn from *L'Intransigeant* that the streams of Chili are being successfully stocked with salmon, carp, tench, gudgeon, and eels. The spawn and the young fishes have been brought not from California, but from France.

Sardines on the West Coast of France.—Last year sardines re-appeared on the French coast in dense masses, just as piscicultural authorities were discussing the causes of their presumed disappearance. The sardine does not spawn in French waters, and the causes of its periodical return have not yet been detected.

DISEASE HEREDITY.—Dr. Brown Séquard and Mr. Combemaille, in a memoir submitted to the Academy of Sciences, describe the morbid affections transmitted to descendants of animals which have been submitted to an alcoholic *regime*, and especially to the *abuse* of absinthe. —*La Nature.*

MIGRATION OF BIRDS.—Mr. H. Seebohn has recently delivered a lecture on this subject in the Tyne Theatre, Newcastle. He divided our migratory birds into three classes; those which, like the swallows and the nightingale, breed with us, and go southwards to winter; those like the fieldfare, which breed in the far north and come here to winter; and those few species which pass through this country in spring and autumn, but neither breed nor winter here. All birds breed in the coldest part of their migrations. Species which breed within the tropics never migrate.

A BLISTERING CICADA.—MM. Arnand and Charles Brongniant describe, is the *Comptes rendus*, a new vesicating insect from China. The species in question is not a *Cantharis*, nor a *Mylabris*, nor indeed, a beetle at all. It is a cicada, *Cicada sanguindenta*, belonging, of course to the Hemipterous order. It is very common in Tonquin, where it feeds upon the *Ailanthus fœtidus*. By the natives it is known as the Cha-ki. Is nearly one and half inches in length, and a black colour, with a red spot upon the head, and the red spots upon the mesothorax. The abdomen is red; the legs and face-wings, are black, and the hind-wings are transparent. A quantity of these insects brought to Europe did not produce distinct vesication, and on careful analysis no cantharidine could be detected in their bodies.

WILD PONIES ON THE SOUTHERN COAST OF CAROLINA.

ON the banks or sand bars that divide the Atlantic Ocean from Pamlico Sound, North Carolina, just inside the lighthouse that marks the dreaded Cape Lookout, there is to be found a hardy race of ponies, known as "bankers." These ponies have lived there as long as the tradition of the oldest inhabitant dates back. Entirely surrounded by deep water at all seasons, having no communication with the mainland, and being barren of vegetation, save a scanty growth of sedge-grass and low shrubs, the banks have remained uninhabited, except by these ponies, which seem to thrive and multiply in spite of the hardships to which they are exposed. How they first came there, or of what origin, is conjecture, and tradition merely hints the story of a violent storm, with its attendant shipwreck and loss of all on board, save a lot of ponies from some European port, which were cast upon the sands, and, surviving the storm, became the progenitors of the race now so numerous.

Having to rely on instinct alone, these animals are a subject of study to the naturalist, as they are a prey not only to the driving sands, but to the storms of the cape, that break upon and over the narrow sand bar, and change with each recurring hurricane the topography of the country. The ponies, choosing the protected side of the hillocks, burrow deep into the yielding sands, and stamp out a protected stall, where they take refuge from the storm; and, while many are destroyed, their number has increased.—*American Agriculturist.*

EXTINCT NORTH AMERICAN BIRDS.

THOSE species of North American birds termed "lost," and excluded from many of the lists in consequence, are at present of considerable interest to many ornithologists, both from the fact that a thorough search may, at any time, reveal the existence of some one, and that within the last few years, two at least, the great auk (*Alca impennis*) and the Labrador duck (*Camptolaimus labradorius*) are believed to have become absolutely extinct.

The first of these, *A. impennis*, has been written and rewritten upon so much of late that we do not wish to say much concerning it here. "It formerly inhabited our coast from Massachusetts north, nearly to the Arctic circle. In Iceland it has been traced down to 1844, while, in the "American Naturalist," vol. vi., page 368, is recorded the finding of a single dead specimen in the vicinity of St. Augustine, Labrador, in November, 1870." Unfortunately, the "character, date, and disposition of this alleged individual are questionable, and it seems improbable that the species lived down to so late a period." At present it is accounted extinct, but, with all due respect to the opinions of others, there seems to us to be still a chance of its being rediscovered, and, strange as it may appear, this chance we would place solely with the Arctic explorer. In the reports of different expeditions we learn that after a certain latitude has been reached, the tide of migration changes its course, and that birds, as well as mammals move, in a northerly direction. This is pretty sure evidence that somewhere at the far north, beyond the region of snow and ice, there is a milder climate to be found, and one undoubtedly teeming with animal life. If, in the years to come, some one succeeds in reaching the Pole, and discovers this land (if existing), does it not seem reasonable to suppose that the great Auk will be found among its inhabitants? which, having experienced the persecutions of man, has sought safety and retirement within its borders. This last borders somewhat upon the Utopian we know; yet time may prove it true, in part at least.

Concerning the Labrador or pied duck, there is still some chance of its being taken, as recently two instances have come under notice in which the birds in question were picked and eaten by the shooter, and afterward, when too late, thought to have been specimens of this bird. In both cases the description tallies very closely with that of a cabinet skin. In a recent number of *Forest and Stream*, Dr. Shufeldt gives an able article on this subject, and strongly holds forth that the bird may still be found.

Leaving these so-called extinct birds, we come to the lost species proper, or those which, through scarcity or diminutiveness, have eluded the efforts of collectors since the original specimens were taken. Four of these have not been seen since the time of Audubon and Wilson, and are known only from their works. These are: The Carbonated warbler (*Dendroica carbonata*), Blue mountain warbler (*Dendroica montana*), Small-headed warbler (*Sylvania* [?] *microcephala*), and Cuvier's kinglet (*Regulus cuvieri*). The others are scarcely of more recent date, and are: Townsend's bunting (*Spiza townsendii*), Brewster's linnet (*Acanthis brewsterii*), Brachman's warbler (*Helminthophila bachmani*), and the Cincinnati warbler (*Helminthophila cincinnatiensis.*)

Eight species once known to science now lost!

Let us take them systematically, and try to discover

the reason, and, if possible, the remedy, for such a state of affairs. In the first place, we must admit that all are small, and therefore less likely to be noticed than otherwise; and secondly, that a number were taken in territory that has never been carefully worked, indeed in one or two localities little, if any, work has ever been done. *Carbonata montana* and *microcephala* were all taken in such regions, namely, the mountains of Virginia and Kentucky, whose vast expanse certainly offers splendid fields for discoveries in this line; and when there, in 1885, on the "Black Ridge" of the Cumberlands in Kentucky, I saw, among others, five of what were firmly believed to have been montana, but owing to circumstances the birds were not secured. *R. cuvieri* is a supposed hybrid between *R. satrapa* and *R. calendula*, and unless exceedingly close could not be distinguished from one of these. Therefore among the thousands upon thousands of kinglets that yearly pass the student, it is not improbable that specimens of this bird exist, and by collecting a large series one or more might be obtained, and a long disputed point settled.

H. bachmani is a well tried and thoroughly established species, and up to within a few years was frequently taken. Several ornithologists have made trips through the localities in which it was formerly known to exist—South Carolina, Georgia, and Cuba—but nothing concerning it has of late been heard. It seems improbable that the species could have become extinct, and future explorations perhaps in comparatively new county, may serve to bring it again to light.

Of *H. cincinnatiensis* but one specimen has ever been taken, and that at Cincinnati, Ohio. It is presumably a hybrid between *H. pinus* (pine warbler) and *Geothlypis formosa* (Kentucky warbler.) If such is the case it is unlikely that it will ever be taken again, and it ought hardly to have a place in this list, as it is considered more of an oddity than a species.

Brewster's linnet (*A. brewsterii*), and Townsend's bunting (*T. townsendii*), are each represented by a single specimen, and remain unique. No one knows to a certainty whether they are hybrids or representatives of distinct species. The one has not been taken since 1881; the other dates from as far back as 1833, when it was taken by Mr. J. K. Townsend, on May 11th, in Chester County, Pennsylvania. It is doubtful whether either will ever be taken again, and if perchance it should, unless taken in sufficient numbers to guarantee its position, it would but confirm the opinion of its being the offspring of two distinct species. This, then, sums up the list, which, with the exception of three, still stand a chance of being rediscovered and placed on the permanent list of North American birds. There is always something peculiarly fascinating about searching for that which is liable to turn up at any moment, and until all disputed points in our ornithology are settled students will continue to search for the desired information.—*Scientific American.*

EARLY SCOTTISH EVOLUTIONISTS.

IN calling attention to the early advocates of evolution in Scotland, we must briefly remind our readers of two points. In the first place evolutionism and Darwinism, though still too commonly regarded as identical, are in reality distinct. An evolutionist is one who is convinced that living organisms have not originated independently, but have sprung from the transformation of a few primal forms, arisen by a process of gradual development out of simpler forms. A Darwinian holds, in addition, that this transformation has been effected mainly by two agencies, natural selection and sexual selection. Hence, whilst every Darwinian is an evolutionist, there are many evolutionists who are not orthodox Darwinians. The second point is, that though we are mainly indebted to Charles Darwin for the victory of evolutionism over the doctrine of "mechanical creation," he was by no means its originator; Buffon and especially Lamarck in France, Goethe and Oken in Germany, and in England Erasmus Darwin, not to mention many lesser lights, had heralded the dawn of the new natural history.

Of these forerunners, Scotland produced two who ought not to be forgotten. The more important of these is the illustrious geologist, James Hutton, whose views on this and kindred subjects have been recently discovered in a manuscript work on agriculture. It is remarkable to find here, that Hutton to some extent anticipates Darwin as regards the agency of worms in the production of arable soil. He uses these words:—"The soil thus enriched with animal and vegetable bodies feeds the worms, its proper inhabitants, which penetrate the soil and introduce fertility as they multiply." This passage might serve for a very condensed summary of Darwin's treatise, though he was not merely in ignorance of the very existence of Hutton's manuscript, but worked out in detail the idea here presented as a sketch.

But turning from this collateral subject let us look at Hutton's views on life. He writes:—"Were plants always, to propagate bodies in all respects the same as themselves, we could have no variation. But we have great varieties in plants of the same species; consequently this conclusion must be admitted, that the race may deviate in some measure from its parent." He complains that botanical philosophers, whilst occupied with the necessary business of distinguishing and describing plants, "have *but little penetrated into the laws* of vegetable economy."

Further, though writing more than a hundred years ago, he ventures to call in question the fundamental dogma of the old school, "That those bodies are only of one species which can propagate, so that those are of different species which cannot propagate in continuing that breed." He then proceeds:—"Let us consider what is the nature of this rule of our forming. If it be absolute as implying no propagation at all between different species, in that case every hybrid would transgress our present system of specific distinctions by uniting in one species, things which we are constrained to believe diverse. If, again, the rule be not absolute, it must be conditional. And now we may inquire into the nature of those conditions: how different species may be allowed to propagate together, but this hybrid body must not propagate again. But hybrids have been known to propagate, therefore we are obliged to abandon that precise condition and assume a new one, one which is again conditional, viz., that the second hybrid should not propagate."

If we make allowance for the backward state of every department of biology in the eighteenth century, if we make due allowance for the incubus-like weight of old, traditional notions, and for Hutton's awkward style, loaded with repetitions, we shall see that he was not far from the evolutionist position. It is somewhat remarkable that Hutton does not allude to the speculations of

Buffon on evolution, nor even to the writings of a neighbour of his in Berwickshire, Lord Kaimes. This author, whom we may also rank as an early Scottish evolutionist, published in 1776 a work entitled the "Gentleman Farmer." Here he says:—"What means were employed at the creation to cover the earth with plants may be *conjectured*, but is far beyond the reach of evidence. It is to me a *rational conjecture* that a number of plants and animals were originally created and endued with proper powers of generation, and from these all the plants and animals existing in the world are descended."

This passage reminds us of Darwin's view on the beginning of life upon the earth, as given in the "Origin of Species." Lord Kaimes had, however, evidently no conception of the fundamental oneness of plants and animals.

Returning to Hutton, we find that he discusses degeneracy, both in plants and animals, fully appreciating both internal and external causes. But it is when treating of animal life that he approaches so closely upon the doctrine of natural selection that we might almost call him a Darwinian before Darwin. Thus we find the following most significant passage:—

"To see this beautiful system of animal life (which is also applicable to vegetables), we are to consider that in the indefinite variation of the breed the form best adapted to the exercise of those instinctive arts by which the species is to live will be most certainly continued, and will be always tending more and more to perfect itself by the natural variation which is continually taking place. Thus, for example, where dogs are to live by the swiftness of their feet and the sharpness of their sight, the form least adapted to this manner of chase will be the first to perish."

If we try to give the process here described a distinct name, it must assuredly be "natural selection."

We have no reason, however, to conclude that Hutton saw how far-reaching were the principles which he was laying down. In any case he drew no general conclusions. He clung almost too closely to the bare facts, shutting his eyes to their ultimate bearings. Hence Professor Huxley accuses him of being false to his own system.

ATMOSPHERIC DUST.

"RUINS of ancient cities and buildings," says the *Popular Science Monthly*, "are nearly always found wholly or partly buried. The material with which they are covered has been supposed to originate in the *debris* of buildings that have been erected and human works that have been going on upon their sites, but this cannot always or seldom wholly be the case; for the same fact appears in desert and wilderness sites. Much is possibly due to superficial disintegration and the work of vegetation, but another factor may be sought in the deposition of atmospheric dust. In a paper on this subject read before the Geographical Society of Paris, M. Violet d'Aouest referred to Richthofen's account of a vast aerial formation of loess in China, and described his own observations in Mexico. Here he found on the flanks of the highest mountains argillaceous strata not deposited by waters nor by the decomposition of rocks, but produced by dust raised by the winds from the plains and deposited on the hills. These deposits varied from 100 feet to—in some places—more than 300 feet in thickness."

Reviews.

Home Experiments in Science for Old and Young. A Repertory of Simple Experiments with Home-made Apparatus. Including Mechanics, General and Molecular Physics, Soap-Bubbles and Capillarity; with Detailed Instructions in the Necessary Mechanical Operations, and Illustrations of the Experiments and Apparatus. By T. O'Connor Sloane, E.M., A.M., Ph.D. London: Sampson Low, Marston, Searle and Rivington. Price 6s.

This book, though published in London, is evidently of American origin, as we may learn, amongst other grounds, from the fact that American firms are mentioned as supplying articles required in some of the experiments (p. 211). Certain portions of the work bear a very strong resemblance to a recent book, of Mr. Johnston Stephen, entitled, "Playground of Science." This similarity appears in several of the subjects here brought forward, and even in some of the illustrations. Of course, not having Mr. Stephens' work before us, we have no right to say that any of these, *e.g.*, figs. 43 and 45, are identical.

In the very outset, Mr. Sloane makes some very just remarks on teaching and learning science. He writes:—"Natural science cannot be properly studied without practical work. The mere cold statement of a fact never effects the same lodgment in the mind that the experiment performed by the observer does. . . . In all advanced systems of education this is fully recognised. From the Kinder-Garten to the advanced University course practical work is the keynote of training." In England for "is" we must read "should be."

The author recommends beginners and amateurs to make their own apparatus. He even goes so far as to say that "the true lover of science will learn more in constructing his own apparatus for his initial studies than if the goods from the store have been used by him from first to last." This we may be permitted to doubt. The time the beginner has at his disposal is often very limited, and might, we think, in many cases be more usefully employed than in making apparatus. But as regards glass-blowing, and consequently the production of the bulk of chemical appliances, the author takes a different view. He writes:—"Frequently glass-blowing is required and the best general advice to be given to those intending it is Sidney Smith's (?) classical advice to those about to marry—"Don't."

We find here the following distinction drawn between mechanics, physics, and chemistry. Mechanics is the science of mass, physics of molecules, and chemistry of atoms." Now we can fully admit that the concern of mechanics is with masses, but chemistry, we submit, has very much to do with molecules. In every decomposition a molecule is split up, in every re-composition or synthesis a molecule is built up.

The last chapter is directed to a subject which we should certainly never expect to find here introduced, viz., the art of lecturing! Mr. Sloane writes:—"In America every man should possess, in some degree, the art of public speaking—the power of thinking when standing before an expectant body of auditors. Many owe no small part of their advancement to this power!"

In England we have far too much speech-making, speech-reporting, and speech-reading, and this excess of verbiage is one of the reasons why as regards discovery and invention we are so hard pressed by certain rival nations. The scientific man very rarely, if ever, requires the art

of "thinking on his feet." When laying, *e.g.*, any new discovery before a society not only the ideas but the very words have to be elaborated beforehand, so that nothing may be open to misunderstanding or mis-interpretation.

Old and New Astronomy. By Richard A. Proctor. London: Longmans, Green, and Co. Part I. Price 2s. 6d.

The first section of this work, which will be completed in twelve parts, now lies before us. The greater portion of it is devoted to a description of the ancient and modern methods of observing the heavenly bodies. As might be expected, the astronomical character of the great pyramid receives considerable attention, and an account of the ancient observatories of Delhi and Benares is given. Astrolabes and other ancient instruments are briefly alluded to, and the different varieties of the modern telescope are fully dealt with. The work is printed in large type, and is profusely illustrated. From the prospectus we learn that this volume is intended to present in a popular form the latest ideas of physical astronomy, and as we are sure the author will do justice to the subject, we can strongly recommend this work to our readers.

A Treatise on Mathematical Instruments, their Construction, Adjustment, Testing, and Use Concisely Explained. By J. F. Heather, M.A. Revised, with additions, by Arthur T. Walmisley, M.I.C.E. London: Crosby, Lockwood, and Son. Price 2s.

The fact that this work has reached its fourteenth edition is sure evidence that it is greatly appreciated. Mr. Walmisley's appendix brings the information up to date, and amongst the most recent forms of instruments described are Amsler's planimeter, Hedley's dial, Abney's level, Cassell's pocket altazimuth, and a variety of range finders. A few notes on photography are also added, but as photography is now so much used in copying plans and preparing the blocks from which they are printed, we think a little more space might be devoted to this subject with advantage.

We can cordially recommend this work to those interested in the use of mathematical, optical, surveying, or astronomical instruments.

The Journal of the Franklin Institute. Vol. cxxv. No. 747.

Among the more important matter in this number we notice a paper on "Heating Cities by Steam," a subject to which the present severe season lends exceptional interest. To have an entire city warmed to such a degree that its streets could never be blocked by snow-drifts, or rendered dangerous by shot-ice — glass-bottle, as it is called in North England—would be indeed a triumph. But wherever practicable it would surely be better to bore into the earth until hot water is reached, and let this circulate through the streets. Professor E. J. Houston discusses the Paillard "non-magnetic watch," in which an alloy is substituted for steel in the balance and springs.

My Telescope, and some Objects which it shows me. A Simple Introduction to the Glories of the Heavens. By A Quekett Club Man. London: Roper and Drowley, 1888. Price 2s. 6d.

This is a simply written little introduction to the study of the heavenly bodies. It contains a very brief description of a telescope, and short accounts of the sun, moon, planets, star clusters, nebulæ, and coloured stars. It is illustrated with ten plates, but, unfortunately, they are so roughly drawn that they convey but little idea of the objects themselves.

THE ENUMERATION OF ORGANISMS IN THE AIR.

THE determination of the number of micro-organisms in a certain quantity of air has attracted the attention of many investigators. This is owing to sickness and death in man and animals being traceable to the existence of these germs. Twenty-seven years ago Pasteur used a very simple appliance to determine their number. He prepared several hermetically sealed flasks, of definite size, containing small quantities of a nutritive liquid, from which the air had been expelled by boiling. On breaking off the sealed end a certain quantity of air rushed into the flask, carrying with it the micro-organisms which it contained. The flask was then resealed, and if any microbes had been carried in, their presence would in due course be observed. Out of twenty such flasks which Pasteur exposed in the country at a distance from all towns or villages, eight, after suitable incubation, showed alterations, which indicated the presence of the germs. Out of twenty flasks, into which air from the Jura mountains was admitted, five became contaminated, and out of twenty flasks exposed in the Montanvert, at a height of 6,500 feet, only one became infected.

Eleven years ago Tyndall adopted a different method to ascertain the same result. He constructed a square table provided with 100 small openings, in each of which was fixed a test-tube, containing nutritive fluid, which had been properly "sterilised," or deprived of all germs by heat. This set of tubes was daily watched, being open at the top to admit the air and its contents. He observed that the tubes did not all make the same change; that the changes took place at different times, dependent on the position of the tube; and that these changes varied according to the particular kind of organism with which the individual tube had become infected.

Three years ago, MM. Freudenreich and Miquel at the Montsouris Observatory, Paris, further elaborated processes for the quantitative estimation of the micro-organisms in the atmosphere. They aspirated a definite volume of air through a plug of sterilised glass-wool, which was then agitated with a definite volume of sterilised water, so as to distribute the collected organisms in the water. The water was then divided into a number of equal parts, each of which was added to a flask containing sterilised nutritive liquid. The volume of water with which the plug was agitated was so selected that when divided into the given number of equal parts, the micro-organisms were so attenuated that only a part of the whole number of inoculated flasks became infected. Owing to that circumstance they argued that the organisms had been very widely distributed in the water.

In 1881, Koch first applied a solid nutritive medium to the examination of air for microbes by exposing glass slides, on which was the solid—peptone-gelatine, potatoes, etc. On that surface the micro-organisms were deposited from the air; these germs were suitably incubated, and the colonies of organisms were counted and examined.

Koch's method was a new departure in the examination of air. It was further developed by Hesse, who, by gently aspirating air through wide glass tubes (30 inches long, and 1½ inches diameter), which had been previously coated internally with peptone-gelatine, found that the whole of the micro-organisms were deposited on the walls

of the lower half of the tube. This method is preferred by those experimenters who employ a solid material for the cultivation of micro-organisms; whereas the method of the Montsouris observers has most favour from those who germinate the organisms with liquid food.

Dr. P. F. Frankland has lately contributed an admirable critical paper on this subject to the Royal Society. He objects to the process adopted by MM. Freudenreich and Miquel, for several reasons. By it each individual experiment is attended with great expenditure of time, trouble, and material, for the water with which the glass-wool plug is agitated has to be divided amongst a large number (ten, thirty, forty, or more) of culture-tubes in one single experiment.

Again, as it is necessary in the process to have the water with which the glass-wool plug is mixed so divided that each part shall only contain *one* organism, it becomes very tedious to dilute the water in due proportion to secure this condition. For should the quantity of water taken for mixing be wrongly proportioned, the experiment would be worthless, as no calculation with regard to the number of micro-organisms could be made.

Again, the assumption that each tube suffering alteration does so in consequence of the introduction of a *single* organism must be accepted with much reserve, more especially as the difficulty of equally distributing the organisms in the water, however carefully and regularly shaken, is rendered almost insurmountable through the presence of the suspended particles of glass-wool.

Dr. Frankland has for a time been adopting Hesse's method for carrying out a number of experiments on the distribution of micro-organisms in air. The method possesses the great advantage that the tubes, after preparation in the laboratory, can be carried to the place where the experiment is to be performed, and that there are no further operations requiring special appliances. Special precautions, however, are needed in hot weather, when the experiments are made in direct sunshine, to prevent the melting of the gelatine film. He found, too, that the number of organisms deposited in the tube was greater when pointing towards the wind than when pointing away from the wind. In consequence he directed the open end of the tube at an angle of 45° above the horizontal towards the wind. In this way the wind does not blow down the tube. But he has latterly exposed, side by side with the tube through which the air was aspirated, a second similar tube by way of control, and he has ascertained that the number of colonies making their appearance in the control-tube frequently amounted to a large fraction of the number found in the tube through which the air had been aspirated.

LITTLE THINGS THAT KILL.

AT various times the newspapers have warned the public against swallowing the seeds of grapes, oranges, etc., because of the danger of such substances getting into a small intestinal bag, or *cul-de-sac*, called by doctors the appendix vermiformis. This is a receptacle formed at the junction of the large and small intestines, but its use or object no physician knows. It has been thought to be a rudimentary or incomplete formation, or possibly some meaningless survival of a lost anterior type. At any rate, its existence, while presenting no apparent "reason for being," as the French say, is, on the other hand, a positive and constant source of danger, because of the liability of its becoming the receptacle of some undigested seed or other indigestible substance. In that case it produces a state of inflammation, which, in nearly all cases, proves fatal. Fortunately but few seeds among the great number so heedlessly swallowed seem to get into this little death-trap, although any one seems likely to lodge. Perhaps more cases of inflammation of the bowels than the doctors suspect may be, in reality, due to this obscure and disregarded cause.

WASTE.

THE complete erasure of the word "waste" from the dictionaries—at all events, in so far as it has any relation to industrial products—is, if not quite an accomplished fact, undoubtedly becoming more and more imminent; and we may thank the chemists of this generation for teaching us how to recover and utilize innumerable substances which, in their ignorance, our grandfathers threw away. Thirty years ago the manufacturers of iron, gas, and chemicals everywhere neglected all but the prime objects of their industries, whereas to-day, on the system of taking care of the pennies and allowing the pounds to take care of themselves, competition has induced us to regard our legionary by-products as so many integral parts or branches of each enterprise. If the intelligent men who have "gone before," and who were looked upon by their contemporaries as wise in their generation, could by any chance reappear among us, we might conduct them to our gas works, and, with a certain pride, explain the origin of our sulphate of ammonia, our aniline dyes, and our hundred other extracts from coal tar. From the contemplation of gas we would turn with them to some of our smelters and furnaces, and point to the mineral wool, the cement, the glassware, the pottery, the fire bricks, and the fertilizer, all derived from our furnace slag; and finally, entering a great chemical works, we should show them how the once devastating gases, so fatal to life and vegetation, are no longer sent free into the air, but are condensed and transformed into staple articles of trade; and how by an ingenious, and, to them, undreamed of process we extract the precious metals from our exhausted sulphur ores. To their wondering question, "How can these things be?" we might reply that all these marvels result from a modern and enlightened policy, which, in many countries, has fostered every species of research in every branch of science, encouraged great minds to ponder over and gradually unravel the mysteries of nature, and stimulated a general thirsting for that knowledge which, properly applied, must ever ameliorate our condition in this "vale of tears."—*The Age of Steel.*

THE DEATH-RATE IN GREAT CITIES.—The *Bulletin Medical* gives the following as the death-rate of thirty great cities, excluding London:—Brussels, 15 per 1,000; Amsterdam, the Hague, and Philadelphia, 16; Stockholm and Baltimore, 17; Dresden, 18; Vienna and Turin, 19; Berlin, New York, and Brooklyn, 20; Paris, 21; Christiania, 22; St. Petersburg, 23; Venice, 24; Budapest, Bombay, and Calcutta, 25; Rotterdam, Breslau, and Prague, 26; Munich, 27; Hamburg, 29; Trieste, 30; Copenhagen, 31; Alexandria, 35; Rome, 37; Madras, 43 and Cairo, 51.

Abstracts of Papers, Lectures, etc.

ROYAL INSTITUTION.

On March 15th the Rev. Dr. Dallinger delivered his second lecture on "Microscopical Work on the Least and Simplest Forms of Life."

He discussed in this lecture more closely the life-history of the saprophytic microbia, taking up more especially the species which appear on applying higher temperatures to an apparently exhausted putrescent solution. In order to study their development under the microscope, it was necessary to keep them at a temperature of about 90° F., and to prevent the liquid in which they live and move from drying up by means of an atmosphere of steam. He first described the process of fission, by which a great part of the multiplication of these organisms, the one-seventy-five-thousand-billionth of an inch in diameter, is effected. Each such ovoid body becomes slightly elongated; a depression is formed about the middle, forming a kind of neck connecting two bodies almost like a dumb-bell. This neck becomes longer and thinner, and is finally ruptured, leaving two ovoid bodies like the original form of the parent. These organisms rapidly grow, and then each undergoes fission in the same manner. This process, however, reaches a limit. A microbe in this state coalesces with another; they fuse into one, or rather the upper one is absorbed. Shortly the cell opens and emits a cloud of minute germs, each of which enters upon the same series of fissions as the parent, whilst the membrane which enveloped them sinks to the bottom.

Prior to the introduction of the apochromatic lenses the existence of nuclei in these micro-organisms was known, but we were ignorant concerning their functions. Now it is known that the nucleus is the governing power of the entire cell, and that in it the processes of fission and the development of the flagella take their origin.

In these processes, which vary slightly in each species, we find nothing but law and order. There is nothing of the capricious or arbitrary, each of these tiny beings presenting the record of numberless generations, and bearing witness to the truth of the Darwinian principles of "descent with variation" and of the survival of the fittest.

As already mentioned in our "Current Events" of last week, the evening discourse, on March 16th, was given by Mr. John Murray, of the Challenger expedition, on the "Structure, Origin, and Distribution of Coral Reefs and Islands." The aim of the discourse was to show that since Mr. Darwin put forward his theory of the origin of coral reefs and islands our knowledge has so grown that it needs considerable modification, mainly with regard to the point that the reefs do not necessarily imply areas of depression. A long series of photographs of coral-forming animals and of others co-existing with them, of soundings, charts, and views was shown on the screen, among them being a most interesting photograph of the side of a reef taken by the Hon. Ralph Abercrombie just as a wave was receding. The picturesque effect of coral reefs has often been described in poetic language, but the lecturer thought the question how the reefs were formed was not less interesting. The reefs, we know, are composed mainly of carbonate of lime, and some of the group of animals we call corals have the power of secreting this from the sea water to form their "skeletons." But the water has the power of dissolving carbonate of lime, and so the existence of reefs would seem to be the result of the balance between the selective power of the corals and the solvent action of the sea. The rate of solution, it is ascertained, varies with the temperature, but except for what may be called a film at the top, sea water is nearly ice cold even at the Equator. It is known that there are many more "cones" below the sea surface than those which stand out above it as islands, and telegraph ships have furnished records of many which were unknown to the Challenger staff. It is noticed that reefs exist in the warm surface water areas. The windward side always gets the richest supply of food, and here the coral growth is most vigorous. The trustworthy data for estimating the rate of deposit are but few, and it is doubtful at what depths "building" commences; it may be 10 or 15 or possibly 50 fathoms. It is only round the edges of cones that growth takes place, and the chances of a lagoon getting filled up are small; and when it is, it is generally with blown sand. With regard to vegetation, it is curious to notice that the trees grow right down to the water's edge, though their roots are in salt water. The vegetation is generally richest on the opposite side to that most favourable for coral growth, and here under the trees it is that the villages are found. Very few of the islands rise much above sea level. Even the elevation of Bermuda, which consists mostly of blown sand, is but about 200 ft. Mixed with the carbonate of lime, the result of coral growth itself, there is much that comes from other sources, globigerina, radiolarians, etc., and there is also a well-recognised pteropod ooze. Darwin's experience was very limited in comparison with the knowledge we now have, and it is not surprising that we are able to correct some of his conjectures.

PHOTOGRAPHIC CONFERENCE OF THE CAMERA CLUB.

The second annual conference was opened on March 13th, in the theatre of the Society of Arts, and continued on the following day. The meetings were presided over by Captain W. de W. Abney, the President of the Club, and some very interesting papers were read. Dr. D. G. Thompson in the first paper pointed out the services photography was rendering in medicine and the allied sciences. He mentioned that the vocal cords had been photographed, as also had the interior of the eye. Mr. H. Trueman Wood, M.A., in a paper on the "Application of Photography to Scientific Purposes," referred to its use in astronomy, meteorology, spectroscopy, micrography, and geography. Mr. Traill Taylor described a simple method of correcting single lenses for architecture. Mr. G. S. Waterlow read a paper on "Modern Photographic Engraving and Printing," which we will shortly reproduce. Mr. G. Lindsay Johnson read a communication on "Weights and Measures, and Ten per Cent. Solutions," in which he suggested a new system of weights, so as to avoid the confusion at present existing between avoirdupois and apothecaries' weights. Mr. W. Willis described in detail an "Improvement in the Platinotype Process." A paper was read on the "Present Value of Art in Photography," by Mr. J. F. Mostyn Clarke, in which the author urged that more attention should be devoted to artistic composition. Captain Abney described the "Theoretical Aspect of

Orthochromatic Photography;" he considered that the dye on the plate is reduced by the action of light, and subsequently acts as a developer. Mr. Lyonel Clarke, in a paper on "The Metamorphoses of the Silver Image," gave an account of some experiments he had made on reducing and redeveloping silver prints. Mr. W. F. Donkin described a new form of sensitometer, based on the principle of the pin-hole camera. In the last paper Mr. Andrew Pringle explained the "Application of Centrifugal Force to Washing Emulsions."

ROYAL SOCIETY OF EDINBURGH.

At the meeting on March 5th Mr. J. Murray communicated the report of Dr. A. Günther, keeper of the Zoological Department of the British Museum, on the fishes obtained by Mr. John Murray in deep water on the north-west coast of Scotland between April, 1887, and February, 1888, during which time he was on board the Medusa. The number of species collected in this way, and dealt with in Dr. Günther's report, was thirty-one—three of which had been found for the first time in British waters. Details were given concerning each of the fish so collected, and as to the localities in which they had been obtained—remarks by the reporter upon each specimen being added. Two communications by Professor Tait were read—one on the mean free path and the number of collisions per particle per second in a group of equal spheres, and a second on the compressibility of glass at different temperatures. Professor Haycraft communicated a paper by Dr. E. W. Carlier and himself on the morphological changes which take place in blood during coagulation. The professor explained that the first set of experiments conducted in connection with the research had been in oil, on the lines shown at a former meeting of the Society. The general conclusion arrived at from them had been that glass (the solid substance in this case) acted simply as a mechanical stimulus on white blood corpuscles. The results of the second set of experiments conducted on the same lines, but with the substitution of vaseline for oil, the authors considered as going to prove—notwithstanding the opinion held by some observers that many blood corpuscles break down as soon as the blood is shed—that, in this case, none were visibly breaking down before coagulation occurred. Some had become transparent, but most had retained their vital powers of producing movement.

GEOLOGICAL SOCIETY.

At the meeting held on March 14th, 1888, Mr. W. T. Blandford, LL.D., F.R.S., president, in the chair, the following communications were read:—

(1.) "On the Gneissic Rocks off the Lizard." By Howard Fox, Esq., F.G.S., with Notes on Specimens by J. J. H. Teall, Esq., F.G.S.

The rocks may be classed under three heads:—(i.) the coarse gneisses of Mên Hyr type, (ii.) the light-banded granulitic gneisses or Wiltshire type, and (iii.) the transition micaceous rocks of "Labham Reefs," type intermediate between (ii.) and the mainland schists.

The first are seen in Mulvin, Taylor's Rock, Man-of-war rocks, the Stags, Men Par, Clidgas, Mên Hyr, and Vasiler; the second in Sanspareil, the Quadrant, and adjoining reefs, Labham Rocks, etc., and the third in the Labham reefs.

The gneisses and granulites of several of the islands are traversed by numerous dykes of porphyritic basic rock, seen in Taylor's Rock, Man-of-war Rocks, Sanspareil, Quadrant Rock and Shoals, and Clidgas. These dykes have been disturbed by movements subsequent to their intrusion. They sometimes strike across the foliation-planes of the gneiss and send veins into the latter rock; at other times the strike is parallel to that of the foliation-planes.

The dykes vary in width from 18 inches to several feet.

In his notes on the specimens Mr. Teall says that the rocks may be arranged in four groups:—

1, principally occurring in the outer islands, are of the Mên Hyr type, consisting of felspar, quartz, dark mica, and hornblende. The rocks possess the mineralogical composition of quartz diorite, and may be termed tonalite-gneisses.

2, occurring chiefly in the inner islands, are of the nature of granulitic gneisses and granulites, confining the latter term to rocks in which the quartz and felspar are present wholly in the form of a micro-crystalline mosaic of fairly uniform grain.

3. Rocks showing a passage from the granulitic rocks to the mica-schists of the mainland, as the brown schistose rocks of Labham Reefs. The Enoch rock, a coarse quartzless hornblende schist, also has affinities with the mainland schists.

4. Dykes traversing the gneisses, consisting of porphyritic felspars lying in a ground-mass of hornblende and granulitic felspar. The hornblende is probably secondary after augite, and the rocks epidiorites. The period of dynamic metamorphism, of which the most striking results are seen in the schists of the south-western portion of the Lizard peninsula, was posterior to to the formation of the basic dykes. There is no evidence of igneous action in this district since the period of metamorphism.

(2.) "The Monian System." By the Rev. J. F. Blake, M.A., F.G.S.

The object of the author was to show that the whole of the rocks, which, under various names, had been described as Pre-Cambrian in Anglesey constitute a single well-characterised system, of which the various divisions hitherto described are integral and inseparable parts.

The evidence of these rocks being Pre-Cambrian was first discussed, and it was shown that the greater part of it went no further than to prove them Pre-Ordovician, the basal conglomerates being associated with rocks of Arenig age, though from the occurrence of these conglomerates on Holyhead Island it was inferred that the previous denudation had been great. The rocks of the eastern district, however, are proved to be Pre-Cambrian from the basal Cambrian rocks of Bangor type lying on them unconformably near Beaumaris and near Redwharf Bay. The rocks described are found in six distinct districts in Anglesey.

YORKSHIRE COLLEGE ENGINEERING SOCIETY.

Mr. A. H. Meysey-Thompson, on March 12th, read a paper on "Pumping Machinery," before the Society. By means of drawings and photographs the author traced the progress of the steam-pumping engine from Savery's engine (patented 1698, and which still survives in the "Pulsometer") to Newcomen's and Watt's engines, which were unable to be worked with a high range of expansion of steam. From these developed the Cornish engine, and considering that it was a single-cylinder

engine, working with low-pressure steam, it worked with remarkable economy of fuel. The next step in advance was the compound differential engine invented by Mr. Henry Davey, which worked as economically as the Cornish engine, but without the excessive strains on the pitwork which had hitherto been unavoidable, and which automatically pulled up in case of a sudden loss of load. Numerous attempts had from time to time been made to convey power from a steam engine on the surface to pumps placed in the mine at a distance from the shaft, compressed air, or water under pressure, being the agents most frequently adopted. As the very low rate of efficiency obtained from compressed air prohibited its use for pumping purposes, except in very special cases, hydraulic power had been largely employed. This was of special value in mines liable to flooding, as the hydraulics worked equally well, though buried in water. Mr. Meysey-Thompson exhibited a model and drawings of the arrangements recently patented by Mr. Davey, which enables direct-acting steam pumps to be worked with a high degree of expansion, and consequent economy of fuel, without the necessity of using fly-wheels and similar devices.

ROYAL HORTICULTURAL SOCIETY.

At the meeting of the Scientific Committee on March 13th, a new species of strophanthus (*S. madagascariensis*) was exhibited. The genus is African, of the order Apocynaceæ, or "Dogbanes," the name being derived from the cord-like appendages to the corolla. It is remarkable for the structure and poisonous properties of the seed. The latter somewhat resembles that of the Dandelion, but is larger, and has the silky hairs distributed down the greater part of the shaft. The natives crush the seeds, from which a red oily mass is obtained, with which they smear their arrow points. Several varieties or species are known, but more material is required for an accurate discrimination of them. As a drug, the active principle Strophanthin, is found in all parts of the pod as well as the seed, and is a very powerful poison, one-fiftieth of a grain killing a large dog. It seems likely to prove to be a valuable remedy for deranged action of the heart.

Mr. T. Christy sent a specimen of *Manaca or Mercurio Vegetal root*, the medicinal root of *Franciscea uniflora*, the bark of which contains the active principle Franciscine. The root is of a woody nature, tapering, of a light-brown colour externally, of a cinnamon-brown within. From Dr. J. Hutchinson's experience it would appear to be a valuable new remedy for rheumatism, especially of a certain type.

Mr. Henslow explained the cause of so many Pears being unsymmetrical about their axis. This was only the case when the stalk was not vertical and the want of symmetry increased with its obliquity. He attributed the growth to the effort of the Pear to meet the strain imposed upon the stalk as the fruit increased in weight. The two forces to which it is subjected are gravitation, or the weight acting in a vertical direction, and the tension along the stalk. The resultant of these two forces tended to wrench the fruit from the latter at its point of insertion at the base of the Pear. To meet this strain the fruit thickened in the opposite direction, so that the "hump" is always at the base and on the outer or opposite side of the fruit. The effect often extends over the whole of the outermost half of the Pear, so that a vertical plane at right angles to the one in which the stalk lies cuts the Pear into two very unequal portions. When the stalk hangs vertically, as is more usually the the case in apples and oranges, there is little or no obliquity, so that the fruit grows symmetrically round all points of its axis, the radii of the circular transverse sections being all equal.

LIVERPOOL GEOLOGICAL SOCIETY.

At the meeting on March 13th, Mr. T. Mellard Reade described the large greenstone boulder which has just been placed in the quadrangle of Owens College, Manchester. It was found about 30 ft. below the surface of Oxford-road, Manchester, during the formation of a drain. It weighed between twenty and thirty tons, and was about to be blasted when the Owens College authorities heard of it, and had it brought out as a geological specimen. The large boulder in Sefton Park, which was found at St. Ann's Church, Edgehill, only weighs about seven tons, so that the Manchester specimen is a giant compared to it. This boulder was found in the boulder clay, and therefore had probably been deposited by a glacier which brought it from the Lake District, when the climate of this country was very different from what it is now.

THE FORMATION AND FUNCTIONS OF STOMATES.—I.

If the skin of the under side of the leaf of a land plant be stripped off and examined by transmitted light under the microscope with a power of about 300 diameters, a plate of flat, whitish, transparent cells (very small bladder-like structures) will then be displayed to the view. In this plate of tissue there will be observed, situated at more or less regular intervals, certain little structures which differ from the surrounding cells by their smaller size, their generally roundish or elliptical shape, and by their being divided in half by a line which swells in the middle into a clear, narrow space. They differ still further by possessing minute grains of chlorophyll—the substance which gives the green colour to the stems and leaves of plants—of which the other cells of the epidermis, or the skin of plants is usually destitute. The small clear spaces in the middle of these structures are openings, and, as will be afterwards explained, it is by means of such openings, known as Stomates or Stomata, that very important work is done in the plant, whilst the two parts of the divided oval cell enclosing the opening forms the two guard-cells which by their expansion and collapse regulate the opening and closing of the stomate. A rough resemblance to the arrangement thus produced, would be made by cutting an oval-shaped piece of paper, and then drawing a line over its longer diameter to represent the cell-wall or partition, and finally by cutting out an oval space in the centre to resemble the stomate or orifice; the two portions of the black line then left between the ends of the opening and the margin of the paper would represent the two portions of cell-wall by which the guard-cells are attached. The surface of the whole stomal apparatus, however, is not flat like the paper but roundish, or otherwise, according to the species of the plants bearing them. These stomates arise late in the development of the epidermis, sometimes not until after the expansion of the bud. Their arrangement on the epidermis differs greatly and is dependent upon the

arrangement of the epidermal cells, as, for instance, in the leaf of the horse chestnut, where the cells are stretched greatly in one direction, the stomates have a longitudinal arrangement along the line of growth, the guard-cells being on each side. They may be distributed singly in the epidermis, or in clusters, and either placed above the surrounding epidermal cells, or below them as is frequently the case in leathery leaves.

It is by means of a vast number of such little structures that the leaves of land-plants are enabled to evaporate the superfluous water in a plant, and thus to keep it cool, but their most important use is that in evaporating moisture from the leaves, they tend to maintain a constant upward flow of sap in the woody fibre of the stems and branches, and by this means to aid to a considerable extent in the nutrition of the plant. But practically this evaporation can take place in the presence of sunlight only. When sunlight shines on the sensitive guard-cells before-mentioned it causes them, by absorbing water from the immediate epidermal cells, to swell, and this turgidity produces a tendency to withdraw from each other, and as such withdrawal can take place only in the middle, the ends being fixed, the stomal cavity becomes enlarged. This enlargement is in proportion to the intensity of the sunlight, and on cold dark nights the stomata are closed. The precise manner in which the sunlight acts is not accurately known, but the explanation put forward by Professor Sachs, the exceedingly able German botanist, seems to provide a probable solution of the problem, and is as follows: In the guard-cells are found certain starchy substances which are absent from the surrounding cells of the epidermis, and some of these starchy substances being in a state of solution, and one which is thicker than the sap in the immediately adjacent cells, a current of water is set up from the latter through the thin cell wall dividing them from the guard-cells. This takes place in accordance with the physical law of osmosis, by which two liquids of different densities, when separated by a thin membrane, have a tendency to pass into each other through the separating membrane until a balance of density obtains, the thinner liquid generally causing the most rapid current. The increased turgidity thus produced, as has been stated, enlarges the opening of the stoma, but this dilatation though directly due to the increased volume of water in the guard-cells can be traced back to the sunlight which, acting upon the grains of chlorophyll, formed the starchy substances which in turn set up the current of water from the neighbouring cells, for it is only by the combined agency of sunlight and the green matter in plants that starch, an important food-material found largely in their system, can be manufactured out of the carbonic acid gas in the air. Thus—if Sachs be right—the very process which is engaged in one very important branch of the work of nutrition in plants serves also to set in motion the wonderful apparatus which regulates another branch. It should also be mentioned that the aforesaid authority believes that sunlight also causes the layer of Protoplasm, or living matter which lines the walls of the guard-cells internally, to strongly resist the egress of the water.

(*To be continued.*)

CIDER CULTURE IN FRANCE.—The number of cider-apple trees in France is about 4,290,000, which would form an avenue extending for more than 13,000 miles.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

NAMES OF ANIMALS AND PLANTS.

Some of the provincial names of insects and flowers seem to be curious survivals. Thus in the Back Bone of England to the west of Halifax a spider is commonly known as an "arran," and the common heather as "collans." The former name may be either a survival of the Latin "aranea" or a corruption of the French "*arraignée*," but "collans" as a name for heather seems to be the Latin "calluna," now used as the generic name for that plant. MONTANUS.

THE INTRODUCTION OF INVENTIONS.

Has it ever struck you that the chief difficulty in the way of the inventor comes in after his patent has been secured, and that it cannot be removed by any legislative action? This difficulty lies in the fact that many of our manufacturers have less enterprise than their Continental and American rivals, and shrink from any novelty. At present the more important an invention the greater is the difficulty in introducing it into practice. S. G. R.

PSEUDO-ORGANISMS.

I have somewhere read an account of experiments performed by a M. G. Fournier, in which cells and tubes, apparently organic in their structure, were produced from inorganic matter. I should like to know if these experiments have been continued. Is it not possible that such simulacra of living beings may have been produced naturally, and have been mistaken for the fossil-remains of plants?—S. B.

SPECTROSCOPIC ANALYSIS.

I have got a set of absorption-tubes from Browning to illustrate spectral analysis. Will you or any of your readers kindly explain how to use them? SPECTROSCOPE.

HIGHER EDUCATION.

Whilst our notions of higher education in Britain point chiefly in the direction of more examinations for somebody to pass, the Germans, not yet satisfied with what is being done by their professors, are about founding new institutions for research only. Examinationism can never win against research. The man who has learned to make discoveries is a better man than if he had passed examinations by the gross. HELIOTHEN.

HAND-LANTERNS.

I should like to know if there is such a thing to be had as an electric hand-lantern, giving a fairly powerful light, which could be used in going through woods and game covers at night? The lantern should be very portable, the cost should not be excessive, and the management of the lantern easy.

If there is no suitable electric lantern at present in the market, what is the best kind of hand-lantern for the purpose, burning any of the mineral oils, and where is it to be procured? A SUBSCRIBER.

A SINGING HEN CANARY.

I have a canary which used to sing (not doing so now), and, of course, it was supposed to be a cock bird. Its song was generally heard before dinner and after tea. But when it discontinued singing it celebrated itself in another way, that of constantly laying eggs, which were found in the morning on the floor of its cage. This bird is still producing eggs, sometimes cracked and sometimes with perfect shells, though I do not suppose they would hatch. Have any of your readers known of a similar case? The bird was said by an experienced gentleman to be a "singing hen canary," which explanation appears to be quite correct. F. P. P

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

DESK RULER.—Mr. J. Stebbing, Potterspury, near Stony Stratford, has patented a ruler. This invention has for its object to provide an ordinary desk ruler with means whereby straight and parallel lines may be more expeditiously drawn by hand. Instead of the round ruler, with a plain smooth surface, the invention consists in making a ruler parallel from end to end, and having the exterior grooved, such grooves being pitched fine or coarse according to the distance required between the lines to be ruled.

ELECTRIC BATTERY.—The Electrical Power Storage Company, Limited, Great Winchester Street, London, and H. W. Butler, Wynne Road, Brixton, have patented an electric battery. The object is to provide means whereby the plates of batteries are maintained at the proper distance apart, and injurious contact prevented, whilst allowing proper circulation of the electrolyte. According to this invention there is situated between every two adjacent plates a perforated separator of vulcanite having formed on, secured to or passed through it projections which extend outwards from the sides of the separator.

FUMIGATOR.—Mr. W. Finch, Bridge Cottage, Great Shelford, has patented a fumigating apparatus. It consists of a closed chamber provided with means for heating and vapourising the fumigating substance, a receptacle for the fumigating substance arranged above the means for heating and vapourising same, and a revolving fan for impelling a current of air over the fumigating substance and leading the fumes thereof to an outlet from which, by flexible tubing, they may be led to the place where they are required for use; the whole being arranged in a case permitting access to the heating medium, to the receptacle for the fumigating substance, and for admitting the current of air.

SELF-LOCKING BOLT.—Mr. H. J. Moore, of Clerkenwell Close, London, has patented a self-locking bolt. This invention consists of a lever attached to the handle of the door, so that the bolt is thrown thereby in the required direction. This bolt is slotted in such a manner that a spring lock comes into operation, and prevents the return of the bolt until the bolt of the lock is raised either by the key or inside knob. The number of bolts are not limited, but one lock controls all. An arrangement is also made by which the handle of the door is detached from the lever which throws the door bolt, and consists of two plates, toothed on the face, the one carrying the lever which is intended to throw the bolt running free on the spindle, a helical spring keeping it apart from the other, except when the handle is pulled outward to make them engage.

VAPOUR BATH.—Mr. G. Thompson, Hargate Lane, West Bromwich, Staffs, has patented a vapour bath. The bath, which is box-shaped, is fitted with a sliding perforated seat and a grating for the protection of the feet. The top of the bath is fitted with two horizontal slides, which, when in their closed position, encircle the neck of the bather. A suitable boiler for the generation of water vapour is provided, which communicates directly with the bath by means of a pipe, and indirectly through a second boiler, in which the necessary medicated herbs are distilled. An ordinary vapour bath or a medicated vapour bath can thus be obtained at will. A thermometer is let into the door of the bath. Suitable means for the regulation of the vapour supply are provided under the control of the bather.

STRINGED INSTRUMENTS.—An improvement in musical instruments has been patented by Mr. S. S. Bromhead on behalf of J. D. Loppentein, United States. This invention relates to musical instruments played upon with a bow, and consists in the introduction of a bar into the body of the instrument between its top and bottom, one end of the bar being fastened to the block by which the neck of the instrument is held, and the other to a knob that supports the string holder, thereby forming a longitudinal connection between these points, and also a fulcrum for a cross piece, upon one end of which stands the sounding-post supporting the top of the instrument while its other end is held by a screw, the raising or lowering of which alters the pressure of the sounding-post against the underside of the top of the instrument, and thereby enriches its tone by an increased vibration.

THERMOSTATIC WATER TAP.—An automatic thermostatic cut off for water pipes has been patented by Messrs. W. G. Browne, J. Kelly, W. A. Hemphill, and T. P. Westmoreland, Atlantic, United States. The object is to cut off the water in the supply pipes before the temperature falls sufficiently low to freeze the water. The weighted arm of the valve is held in a raised (open) position by means of a spring bolt fitting into a loop or aperture in the bar, and provided with a nut for adjustment. Upon the bolt is a sliding collar connected to one end of a thermostatic band hinged to the frame. This band consists of four compound bars of brass and steel or two other suitable metals. The two inner bars are hinged together at both ends and the two outer bars are brazed to these. When the temperature falls sufficiently low the bending of the band disengages the bar from the spring bolt, and the valve is closed by the weighted lever. The whole is enclosed in a casing having a hinged cover, and fixed on a support attached to the pipe.

MUSIC RECORDER.—An apparatus for recording extemporised music has been patented by Mr. C. H. Wall and Mr. O. Oström, Aberdeen. A wooden bar runs over the back of the keys and carries above each key two springs, which form the terminals of separate insulated electric wires gathered into ropes. When a note is struck the two terminals are pressed into contact. The circuit of each electric wire includes an electro-magnet which, when excited, draws down a spring metal strip carrying a roller at the end. The roller presses upon a drum over which a paper band is travelling uniformly. The drum being covered with carbon paper, lines are marked on the underside of the travelling band, of length proportional to the tune of the note. A metronome controls electrically two hammers, which mark the paper band to indicate the bars. The rollers, strips and electro-magnets are arranged in two rows, one each side of the drum, and in the order of the keys. When it is desired to translate the music into staff notation the paper band is drawn beneath a glass strip, which is divided into spaces corresponding with the rollers and marked with the staff signs.

ANNOUNCEMENTS.

GLASGOW INTERNATIONAL EXHIBITION.—It is announced that the Prince and Princess of Wales will open the Exhibition on Tuesday, May 8th.

SOCIETY OF ARTS' EXAMINATION IN VOCAL AND INSTRUMENTAL MUSIC.—The next examination in London will be held by Mr. W. A. Barrett, Mus. Doc., Oxon, at the House of the Society of Arts, and will commmence on Thursday, the 24th May, 1888. Full particulars can be obtained on application to the Secretary.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—In connection with the country meeting of the Society, which is to be held at Nottingham next July, prizes are offered for hay and straw presses worked by steam, horse and hand power respectively, and for a press for old hay worked by hand power. Intending competitors and exhibitors must make their entries by the 31st inst.

PARIS INTERNATIONAL EXHIBITION.—It is said that separate catalogues will be issued for each of the following groups of exhibits:—Works of art; Education, and apparatus and materials used in connection with the arts; Furniture and accessories; Textiles, clothing and accessories; Mining, and industries connected with the production of raw materials; Engineering, manufactures, and applied electricity; Food products; Agriculture, viticulture, pisciculture, and horticulture.

DELTA METAL.—On page 53, vol. i., First Series, we described this useful metal, and we are glad to know that the demand for it has greatly increased, so much so, in fact, that a Company has been formed to undertake the manufacture and sale on a larger scale than hitherto. Sir Edward Reed, the late Director of Naval Construction to the Admiralty, is the Chairman; and Mr. Charles Cammell, of the Cyclops Works, Sheffield, Mr. Bond, Messrs. Vivian, Younger, and Bond, Directors; and Mr. Alexander Dick, Managing Director.

BRITISH ASSOCIATION.—The Council of the British Association have nominated the following presidents of sections for the Bath Meeting in September next, and we understand they have accepted the offices respectively:—Prof. Schuster, Section A, Mathematics and Physics; Prof. Tilden, Section B, Chemistry; Prof. W. Boyd-Dawkins, Section C, Geology; Mr. Thistelton-Dyer, Section D, Biology; Col. Sir C. Wilson, Section E, Geography; Lord Bramwell, Section F, Economic Science; Mr. W. H. Preece, Section G, Mechanical Science; General Pitt-Rivers, Section H, Anthropology.

UNIVERSITY EXTENSION LECTURES AT BETHNAL GREEN.—As an outcome of the lectures recently delivered by Professor Seeley, the Committee announce that a class for the study of geology has been formed. Arrangements have been made for the delivery of the following lectures during next month:—On April 5th, "The Metals which form the Earth's Crust; the Cooling and Crumpling of the Earth," by Mr. Nicol Brown. April 12th, "Clouds and Rain; Rivers and Seas," by Dr. Gerard Smith. And on April 19th, "The Development of Underground Heat, Volcanoes and Earthquakes," by Mr. Nicol Brown.

PROFESORSHIP OF BOTANY AT OXFORD.—An election to the Sherardian Professorship of Botany will be held in the course of next term. The duty of the professor is to lecture and give instruction in botany. He will also have charge and supervision of the Botanical Garden and of the botanical collection belonging to the University; and it will be part of his duty to make such gardens and collections accessible to, and available for the instruction of students attending his lectures A fellowship in Magdalen College is now attached to the professorship. The stipend of the professor, inclusive of this, will be £700 per annum. Candidates are requested to send to the Registrar of the University their application, and also any documents which they may wish to submit to the electors, on or before Tuesday, May 1st, 1888.

OXFORD LOCAL EXAMINATION.—The annual report for 1886-7 of the Committee of the Local Examinations Delegacy for the establishment of lectures and teaching in the large towns of England and Wales has been issued, with a map showing the towns where such lectures have been arranged. It appears that the number of such places has increased from twenty-two in 1886, to fifty-seven in 1887, the courses of lectures from twenty-seven to sixty-seven, and that the number attending in the latter year has been 9,908. An endowment fund has been commenced for lecturers to form a permanent nucleus of the teaching staff. The report gives much interesting information as to the correspondence lectures for working men, travelling libraries, to which Messrs. Cassell and Co. and other publishers have made donations, and other matters connected with the scheme. Further information can be obtained through the secretary, Mr. E. Sadler, M.A., Examination Schools, Oxford.

SOCIETY OF ARTS.—The following address has been presented by the Society of Arts to H.R.H. the Prince of Wales, the President of the Society, and has been accepted by his Royal Highness:—"To his Royal Highness the Prince of Wales, K.G., etc., etc., etc.—May it please your Royal Highness,—We, the Members of the Society for the Encouragement of Arts, Manufactures, and Commerce, desire to offer to your Royal Highness our sincere and heartfelt congratulations on the occasion of the twenty-fifth anniversary of your Royal Highness's marriage. We gratefully remember that at the completion of the current Session of the Society, your Royal Highness will have been for twenty-four years President of the Society of Arts, and we feel that this Society owes very much of its prosperity during that time to your Royal Highness's influence, and to the great interest your Royal Highness has taken in its affairs. We earnestly desire that for many years to come you and your Royal Consort may be spared to retain the high position you both hold in the respect and affections of the people of this country; and we trust that the period on which you are now entering may be no less happy than the one you have just completed."

PARKES MUSEUM.—The following course of lectures has been arranged for persons desirous of obtaining a practical knowledge of sanitary requirements and regulations.

April, 10th.—(1) Introductory Lecture — General History, Principles, and Methods of Hygiene. Mr. A. Wynter Blyth, M.R.C.S.
" 13th.—(2) Ventilation, Measurement of Cubic Space, etc. Sir Douglas Galton, K.C.B., F.R.S.
" 17th.—(3) Water Supply, Drinking Water, Pollution of Water. Dr. Louis Parkes, (Pub. Health Cert. Lond.)
" 20th.—(4) Drainage and Construction. Mr. E. C. Robins, F.S.A., F.R.I.B.A.
" 24th.—(5) Sanitary Appliances. Prof. W. H. Corfield, M.A., M.D.
" 27th.—(6) Scavenging, Disposal of Refuse and Sewage. Mr. H. Percy Boulnois, M. Inst. C.E.
May 1st.—(7) Food (including Milk), Sale of Food and Drugs Act. Mr. Charles E. Cassal, F.C.S., F.I.C.
" 4th.—(8) Infectious Diseases and Methods of Disinfection. Mr. Shirley F. Murphy, M.R.C.S.
" 8th.—(9) General powers and duties of Inspectors of Nuisances. Method of Inspection. Mr. J. F. J. Sykes, B.Sc., (Pub. Health) M.B.
" 11th.—(10) Nature of Nuisances, including Nuisances the abatement of which is difficult. Mr. J. F. J. Sykes, B.Sc., (Pub. Health) M.B.
" 15th.—(11) Sanitary Law—General Enactments, Public Health Act, 1875, Model Bye-Laws. Dr. Charles Kelly, F.R.C.P.
" 18th.—(12) Metropolitan Acts, Bye-Laws of Metropolitan Board of Works. Mr. A. Wynter Blyth, M.R.C.S.

The Lectures will be given on Tuesdays and Fridays at 8 p.m., in the Parkes Museum, 74a, Margaret Street, W., and

Students attending the Course will be granted free admission to the Museum and Library from April 1st to June 1st.

In order to put it within the power of every one to attend the Lectures, a nominal fee only of Five Shillings for the course will be charged to cover the necessary expenses.

DIARY FOR NEXT WEEK.

Monday, April 2.—Royal Institution, at 5 p.m. General Month'y Meeting.
Tuesday, April 3.—
Wednesday, April 4.—Entomological Society, at 7 p.m.
Thursday, April 5.—Chemical Society, at 8 p.m.
Royal Society, at 4.30 p.m.
Friday, April 6.—Institution of Civil Engineers. Students' Meeting, at 7.30 p.m. *Coke Making;* Mr. G. E. J. McMurtrie.
Saturday, April 7.—

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Crayon Sketch from any photograph (returned uninjured), 15 by 11, 1s. 2d., free.—Mr. COULTHARD, Bathwick, Bath.

Patterns. — 100 fretwork; 100 repoussé; 200 turning; 300 stencils; 1s. each lot.—COLLINS, Summerlays-place, Bath.

Patents.—Nine months' protection, 50s.; patent completed from £6 10s.—P. M. ROGERS, 21, Finsbury Pavement.

Fretwork Carving.—Catalogue of all requisites and 500 miniature designs free, 6 stamps.—HARGER BROS., Settle.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Meerschaum and Briar Pipes repaired, mounted, or cased; ambers fitted.—W. GEORGE, 324, Essex-road, Islington, London.

Trouser Lengths, 5s., Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—HEWITT, 27, Winfield, Leeds.

Dynamo, 120-candle power, improved armature, 100s. Photo. 5 stamps.—D. WALTON, Hebden Bridge, Yorkshire.

Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps. Castings, lamps, etc.; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s.; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch, London—All Letters, Britannia Tool Factory, Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new appliances, metal spinning, milling, etc., in an ordinary lathe; 3s. post free.—Britannia Company, Colchester.

Minerals.—12 named specimens, 2s. free; 12 lias fossils, 2s. 6d. —CHAS. WARDINGLEY, 30, Blackwood Crescent, Edinburgh.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS., 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

Natural Resources of the United States. By Jacob Harris Patton, M.A., Ph D. London: Appleton and Co. Price 12s. 6d.

Emin Pasha in Central Africa: Letters and Journals. Collected and Edited by Professor Schweinfurth, Professor Ratzel, Dr. Felkin, and Dr. Hartlaub. With Life and Introduction. Illustrated with Two Portraits and a large Scale Map. London: George Philip and Son. Price 16s.

Geometrical Drawing. For the Use of Candidates for Army Examinations, and as an Introduction to Mechanical Drawing. By W. N. Wilson, M.A., Assistant Master at Rugby School. London: Rivington and Co. Price 4s. 6d.

The Geological History of Plants. By Sir J. William Dawson, C.M.G., LL.D., F.R.S. With 80 Figures in Text. International Scientific Series. London: Kegan Paul, Trench and Co. Price 5s.

A Manual of Dissections of the Human Body, for the Use of Students, and more Particularly for those Preparing for the High Examination in Anatomy. By the late R. E. Carrington, M.D., F.R C.P. Second Edition. Revised and Enlarged by W. Arbuthnot Lane, M.S., F.R.C.S. London: George Bell and Sons. Price 9s.

Reminiscences of Foreign Travel. By Robert Crawford, M.A., lately Professor of Civil Engineering in the University of Dublin. London: Longmans, Green, and Co. Price 5s.

A Season in Egypt, 1887. By W. M. Flinders Petrie. Illustrated. London: Field and Tuer; Trübner and Co. Price 12s.

An Elementary Geography of the British Isles. By Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom. London: Macmillan and Co. Price 1s.

California of the South: its Physical Geography, Climate, Researches, Routes of Travels, and Health Resorts. Being a Complete Guide to Southern California. By Walter Landley, M.D., and J. P. Widney, A.M., M.D. With Maps and numerous Illustrations. London: Appleton and Co. Price 8s. 6d.

To the Central African Lakes and Back: the Narrative of the Royal Geographical Society's East Central African Expedition, 1878-80. By J. Thomson. London: Sampson Low, Marston, and Co. Price 7s. 6d.

Aids to Chemistry. Part 1, *Inorganic, the Non-Metallic Elements.* By C. E. A. Semple. London: Bailliere and Co. Price 2s.

Natural History Object Lessons: A Manual for Teachers. By G. Ricks. London: Isbister and Co. Price 4s. 6d.

NOTICES.

The Title Page and Index to Vol. I., *First Series,* now ready, price 6d.

Binding Cases for Vol. I., *First Series,* price 2s. each.

Binding Cases and Binding, Vol. I., *First Series,* including Title Page and Index, price 3s.

Vol. I., *First Series,* bound in cloth, with Title Page and Index, 7s. 6d.—by post 8s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Prices 6d. each, or by post 7d. for the *First Series,* and 3d. each, or by post 3½d., for the *New Series.*

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 14. (*New Series.*) APRIL 6th, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

SCIENCE AT WOOLWICH.—Sir Henry Roscoe did good service by calling attention in the House of Commons to the new regulations respecting the entrance examinations for admission to the Royal Military Academy at Woolwich. Under these regulations the number of marks allowed for experimental science is to be only 2,000, whereas those for languages are to be 11,000. The probable effect of this will be that the successful candidates will be those who have devoted themselves to languages rather than to science, and yet it is admitted that science should "hold the field" in the training after admission. There is an evident inconsistency, but this is by no means all. As Sir Lyon Playfair very truly pointed out, the linguistic capacity of a man is a perfectly different thing from his scientific capacity, and it is obviously important that men should not be admitted who by their entrance examination give insufficient evidence of scientific knowledge or capacity. If, therefore, candidates are admitted for proficiency in languages, how can the examining authorities ascertain whether or not they have the requisite scientific capacity?

The question is also a serious one as regards its effect on the teaching of experimental science at public schools. It is notorious that, as a rule, the head-masters of our schools have no acquaintance with, and no liking for, science. If, therefore, they know that candidates for Woolwich have a greater chance of gaining admission with languages than with science, it is only natural to suppose that they will advocate the former rather than the latter. The effect of this will be that the little progress made of late in the school-teaching of science will receive an unmerited and deplorable check. The high-class work at Woolwich has certainly done much to encourage the teaching of science in our public schools, but, regarded as a pure matter of business, if it be seen by the head-masters and students that science "does not pay," it needs no great stretch of imagination to see that preference will be given to what are believed to be more "paying" subjects. In the interest of the service and of all concerned, we sincerely trust that steps will at once be taken to raise the number of marks allowed for experimental science, and that no discouragement will be given to scientific training in our schools.

MR. CROOKES ON ELEMENTS.—Mr. Crookes, as President of the Chemical Society, delivered a very speculative and somewhat metaphysical address at the annual meeting of the Society, held last week. It is too abstruse and too technical for general readers, but there are some points to which we may venture to draw attention. That undefined but often quoted aggregation of beings, the "ancients," were wont to believe that there were but four elements—fire, air, earth, and water. Modern science, however, already recognises some seventy distinct elements, and at the present rate of discovery there is every probability that this number will be increased. Mr. Crookes, however, raises the question as to the constitution of the so-called elements, and instances some which, he says, are not composed of ultimate atoms, all identical and homogeneous. He is of opinion that the ultimate atoms are in some respects heterogeneous, but that at the same time they are more nearly like to each other than they are to the atoms of any other approximate element. There are, in fact, according to Mr. Crookes, elements and meta-elements.

Doubtless there are cases in which the behaviour of

elements is somewhat irregular, and we are all greatly indebted to such investigators as Mr. Crookes for endeavouring to discover a cause for this irregularity, but we cannot think that his present speculation is likely to advance the subject very much. Moreover, it appears to us that he rather begs the question by asking us to suppose that the atoms of elements are not identical and homogeneous. We have always understood that the word element means a substance composed of an aggregation of molecules, or atoms identical and homogeneous. If therefore, this definition of the word element is to hold good, it seems a contradiction in terms to talk of an element not being composed of molecules or atoms which do not fulfil these conditions. The question concerns not only the fundamental principles of chemistry, but it has a most important bearing on other branches of science; we shall therefore wait with interest its further discussion and development. No one can suppose that what Mr. Crookes has now put forward is to be accepted as final.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Medical science has made many "new departures" during the century, one of the most remarkable of these being the sending of tottering, emaciated patients suffering from deadly lung-disease to spend a winter amid the snows of the Upper Engadine, a region described in Murray's handbook as follows: "Owing to its high elevation, and the icy barrier of enormous glaciers which separates it from Italy on the south, it possesses a most ungenial, nay, severe climate. In the language of its inhabitants it has nine months of winter, and three of cold weather." In spite of this, consumptive patients go there, remain for the winter, and many come back alive. The mechanical purity of the atmosphere at such an elevation is one of the factors to which its curative action has been ascribed; those invisible nuclei which Aitken has shown to be necessary for the production of mists and fogs are exceptionally few, if not absolutely absent up there.

But Aitken showed that burning or subliming sulphur is the most potent of all known sources of fog-producing nuclei, and now, according to the *British Medical Gazette*, a series of observations have been recently made which prove that the inhalation of an atmosphere impregnated with the fumes of burning sulphur, *i.e.*, sulphurous acid, operates most beneficially in arresting the progress of pulmonary tuberculosis. Means of effecting such impregnation, such as a lamp burning carbon disulphide, etc., are described, but all these are objectionable in a well-appointed house on account of the bleaching of upholstery and corrosion of metal work which sulphurous acid effects. If, however, no other means are available, these ornaments must be sacrificed rather than the lungs of their proprietor.

But there is a sanitorium within easy reach of the London merchant who cannot leave his office to winter in the Engadine or on the Riviera. There is the underground railway. A season ticket between Moorgate Street and Edgware Road will provide him with luxurious cushions on which he can lounge at ease in the intervals of business, read his daily paper and Scientific News, while breathing an atmosphere constantly supplied with the curative sulphurous acid. If this suggestion be successfully adopted, the enterprising chairman of the company, Sir Edward Watkin, will be supplied with another argument in favour of his Channel Tunnel project. If the short tunnel of the Underground Railway, with its numerous blow-holes, shafts, and station openings into the upper air still retains so notable a supply of sulphurous acid, how great will be its abundance in a tunnel with a clear run of twenty miles under the sea, where no such blow-holes, air-shafts, or station outlets will exist.

The origin of petroleum has suggested many theories, the latest being that of Professor Medeleieff, who supposes that water finds its way below the crust of the earth until it meets with carbides of metals (particularly iron) in a glowing state. The water is decomposed, its oxygen uniting with the metal, while its hydrogen takes up the carbon and ascends to a higher region, where part of it is condensed into mineral oil and part remains as natural gas, to find an outlet or remain compressed until a borehole liberates it. We are told that he has made an artificial hydrocarbon corresponding to the natural product by imitating the theoretical conditions.

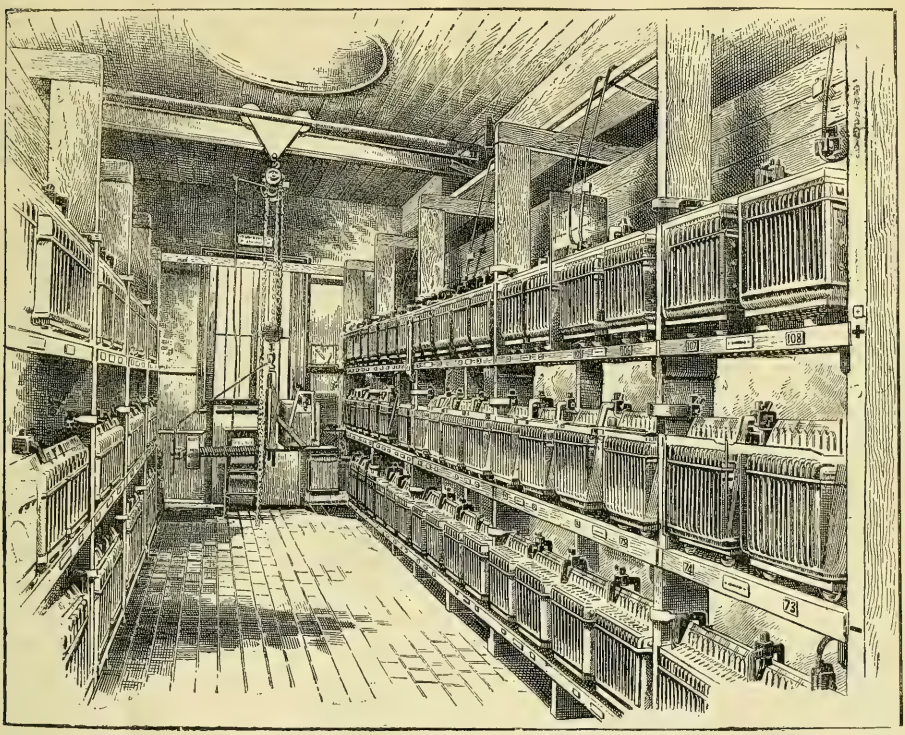
My own theory, founded on practical experience in the distillation of cannel coal and bituminous shales in Flintshire, is that what we did in our oil retorts, and what is still being done in Scotland, in order to obtain British paraffin oil, has been done more effectively and on a grand scale by the internal heat of the earth acting upon coal seams and bituminous shales. Such heat, combined with pressure, would separate the volatile hydrocarbons from coal and leave behind a compressed coke, or anthracite, such as exists so abundantly in America. The liquid and gaseous hydrocarbons would permeate the porous rocks of the coal measures as water does, and travel as water does until it finds an impermeable rock. If such impermeable rock should contain cavities the petroleum would settle there and remain in storage until liberated by man or by natural disruption of the rock.

Petroleum is found in limestone rocks, and as everybody knows limestone rocks are especially addicted to caverns, mainly because percolating water dissolves them gradually. Such limestone rocks underlie the carboniferous rocks, very conveniently for such storage. When an oil well is first struck it usually spouts—that is, throws up a column of oil into the air. This gradually subsides, and is followed by a rush of gas. After this no more oil rises spontaneously; the spouting well becomes a pumping well—one from which a certain quantity can be obtained by pumping. In some cases the gas comes first.

This is easily explained. If the borehole proceeds directly to the highest part of the irregular roof of the oil-filled cavern, the compressed gas at once escapes. If, however, it strikes into a lower part of the roof below the level of the oil surface, the elasticity of the compressed gas above projects the liquid oil until its expansive energy is exhausted, or the level of the oil reaches the borehole. Then no more oil rises without pumping.

In spite of proprietorship I hope that Medeleieff's theory is correct rather than mine, for if it is, the supplies of mineral oil and natural gas will be practically unlimited as lower and lower depths of the earth's interior may be tapped for further production. If I am right, there must be a definite limit to the supply, as there is to the coal supply of any particular district, and as we are rapidly proceeding towards the exhaustion of the coal in our

small island, it is most desirable that we should continue to import petroleum oil from other parts of the world in order to diminish the extravagant demand upon our coal which arises from gas making. I fear, however, that the present rate of working the American wells will ere long exhaust them. We may then obtain supplies from Baku on the Caspian, and also by distillation of the vast deposits of Scotch shale, but it will be more costly than at present, and both Russian oil and shale oil are inferior to that which is obtained from the American oil wells. The above applies equally to the supplies of natural gas which of late has been as largely used in America both as fuel and for lighting.



Accumulator Room at Broomhill, the Residence of Sir David Salomons, Bart., F.R.S.

ELECTRIC ACCUMULATORS.

ELECTRIC accumulators, or storage batteries, are supposed by many people to contain, when charged, a store or supply of electricity, much in the same way as a Leyden jar is said to be charged. The expression, "storage of electricity," is convenient, but it is not accurate. The same may be said of the "flowing" of an electric "current." The name, "secondary battery," is more accurate, but it is seldom used.

The simplest form of primary battery is a pair of plates—the one of zinc, the other of copper—in a vessel of dilute sulphuric acid. When a current of electricity is allowed to flow from the copper to the zinc, a chemical action is set up, and the acid attacks the zinc, forming sulphate of zinc, while hydrogen gas is given off at the copper. If, by forcing a more powerful current in the opposite direction, we could undo this action, and deposit the zinc on the plate again, as in electrotyping, we should have a secondary battery; but this is not practicable.

If, however, we take two lead plates and coat them, one with peroxide of lead and the other with monoxide of lead or litharge, and place them in dilute sulphuric acid, we shall have a powerful battery which has the great advantage of retaining its force until nearly exhausted, instead of gradually running down. The chemical changes which take place during the discharge have formed the subject of a considerable amount of discussion, and the leading authorities differ very considerably in their views. One theory is that both the coatings become sulphate of lead; another that there is merely a change in the quantity of oxygen in the oxides; and again, that one plate becomes so reduced by the hydrogen that the oxide becomes spongy metallic lead.

Whatever the change is, we can bring the plates back to a condition in which they are again ready to give a current of electricity, by sending a current in the opposite direction until no further chemical change takes place, and the passage of the current merely decomposes the water into oxygen and hydrogen, which come off in bubbles.

Such a pair of plates, however, would not last for any length of time; the oxides would be liable to peel off, and the plates would warp and bend from unequal action. In practice, the plates are made of an alloy which resists the acid better than pure lead, and which is nearly as strong as iron. The plates are cast in the form of a grid or honeycomb, and the oxides, as pastes, are pressed into the holes, and thus not only is a much larger quantity of active material used, but it is firmly held in the holes of the plates.

The charging current should be of sufficient strength, or the process will go on very slowly, while it must not proceed too fast, or the plates will buckle, and the plugs of oxide may fall out. Damage may also be done if they be discharged too rapidly, and if they be allowed to "run down" the sulphuric acid will attack them, and form a white insoluble coating which will spoil them. External leaks by which one cell, as a box of plates is called, may run down, and internal leaks or short circuits by which a cell may be rapidly discharged, have to be prevented and detected, and the expansion and contraction of the plates must be provided for. The strength of the acid should be measured from time to time, and kept to the right density, and precautions must be taken against the scaling of the plates and the loosening of the oxide in the form of mud. These and other causes of failure have done much to retard the more general use of electric accumulators; but one by one precautions have been taken and improvements have been effected by which a set of accumulators can now be placed under the charge of any intelligent workman. Considering the state of the few sets of batteries, which have been in use for more than three years, and the improvements which have since been made, these accumulators, if carefully managed, should last for five or six years.

Strange as it may appear, only one book has been written on this subject, and we gladly draw attention to it, as its value is unquestionable for those who are concerned with private electric light installations. We refer to the "Management of Accumulators" (Whittaker and Co.), by Sir David Salomons, who has done so much useful experimental work in many branches of electrical engineering. From an electrical point of view, his residence in Kent is a model, and his workshops and laboratories are also fitted up in the most complete and elaborate way. Our illustration shows the accumulator or battery room at Broomhill, and the convenient method adopted for handling the cells by means of a balanced travelling pulley. The author gives directions for the management of the accumulators, and he describes the various difficulties that may arise, their causes, and the means for their prevention and cure. This little book has just reached its third edition, and although we cannot agree with all that is stated on the subject of the initial cost and the working expenses of the electrical plant said to be necessary for a private house, the general information it contains on the management of accumulators cannot but be useful to all interested in these appliances.

MICROSCOPIC WORK FOR YOUNG ENTOMOLOGISTS.

WE propose to give a few simple directions to the beginner who wants to know how to mount the hard parts of common insects. The cockroach is by far the best subject for practice. It is so common that the material may be freely and even wastefully used, without loss to mankind or womankind; the parts are tough enough to bear rough handling; and the creature is one of those primitive types which constitute excellent *points de repere* for the student. We shall show how to treat the head of the cockroach, for after this is mastered the rest of the body is easy by comparison.

Cut off the head, and divide into front and back halves with a sharp scalpel. The stout mandibles should come off with the front half; the other jaws with the hinder half. Several heads should be treated one after another, till the operation can be performed quickly and well. Cut the antennæ short with scissors. Put all the successful preparations into water, till the time comes for clearing. From a fresh specimen strip off the labium, which hangs down from the back of the head. The labium must be grasped between the thumb and the scalpel, and torn off gently. Remove, also, the maxillæ of the first pair with scalpel or fine scissors. When the labium and first pair of maxillæ have been stripped off, the rest of the head is useful for demonstration of the tentorium, or internal skeleton, and may be popped into water with the rest.*

The next thing is to dissolve away all the soft parts, muscles, nerves, brain, and fat. This is soon done by boiling in a porcelain saucer of liquor potassæ. After five minutes' boiling, pour off the solution, wash two or three times with water, then add dilute acetic acid, and leave the parts to soak in it for a few minutes. Wash again with water, and afterwards transfer successively to methylated alcohol, absolute alcohol, and oil of cloves. Ten minutes in each fluid will generally be enough. The parts are then ready for mounting in balsam. Arrange each preparation on a cover-glass. The oil of cloves which adheres need not be removed. Place three small glass beads, or other fragments of glass, on the slip, so as to receive the edges of the cover, and keep off pressure from the preparation. This precaution is not necessary in the case of very small objects, such as the labium. Lower the slip, and then add the balsam from one side. Hard balsam, thinned with benzine to the consistence of cream, is best. When the balsam is quite hard, trim the edges, and clean with a rag dipped in benzine, carefully avoiding all dangerous pressure upon the cover. The dissection of the tentorium may be mounted dry in a cell, as follows:—Cement an ebonite ring to a glass slip with balsam. Line the bottom of the cavity with a circle of black paper, and fix the head in the centre with any good transparent cement, such as coaguline.

After a few evenings' practice, any of the hard parts of the cockroach can be dealt with. Go on with the mouth parts of other insects. Beetles are very easy, except when of microscopic size. Where the parts are flexible and long, as in Lepidoptera, some management and skill are wanted. Brushes of various sizes and bristles, mounted in handles, are useful in laying out such preparations. Patience and mother-wit will carry the operator through all his difficulties.

* Descriptions of the head of the cockroach will be found in Huxley's "Comparative Anatomy of Invertebrates," or Miall and Denny on "The Cockroach."

FOSSILISED HUMAN FOOTPRINTS IN NICARAGUA.

A FEW years ago attention was drawn to certain foot-marks discovered in a bed of limestone at Carson in Nevada, and a discussion was raised as to their probable origin.

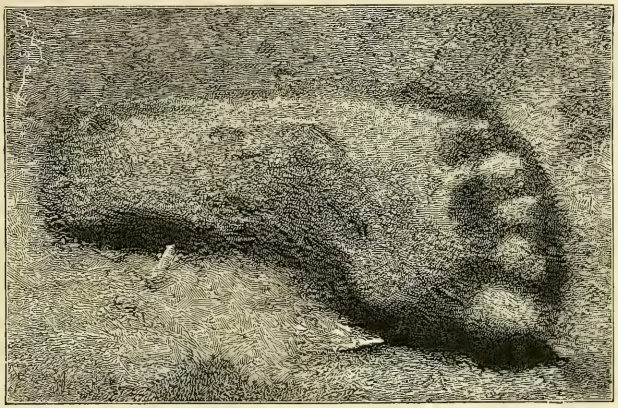
The Marquis of Nadaillac has recently communicated to *La Nature* an account of footprints found in Nicaragua, and which, unlike those of Carson, are indisputably human.

The entire region of Nicaragua gives signs of an intense volcanic activity, which is very far from becoming exhausted, but the frequently-renewed eruptions and their consequences have not prevented the surrounding country from becoming inhabited. The rocks overhanging the lakes of Managua and Nicaragua are covered up to great elevations with ancient inscriptions and designs. Even as far back as the conquest, four centuries ago, the Spanish invaders were struck by these designs, though no tradition of their meaning has survived. The Indians cannot (or will not?) understand them, and no data exist to show at what epoch they may have originated.

Among the volcanoes now extinct must be counted that of Tizcapa; its eruptions have become irregular and are separated by intervals of quiet sufficiently prolonged to allow luxuriant vegetation to spring up upon the deposits of lava and tufa which are slowly decomposing. Of this the vegetable remains which have been found in several successive strata furnish a sufficient proof. At the arrival of the conquestadores, tranquillity had prevailed for ages, if we may judge from the almost impenetrable forests which they describe as covering all the shores of the lake.

The human footprints have been discovered in one of the strata just mentioned, not far from the town of Managua, at a distance of 300 feet from the lake, and at a depth of twenty-one feet. Below the bed of humus formed by the accumulating detritus of the forest, there are found four successive layers of compact tufa, separated by thin beds of sand. The last of these strata has become a true limestone, which the inhabitants still make use of at the present day for building their houses. All these deposits rest upon a bed of ashes, forming a conglomerate of fourteen inches in thickness. These ashes must have been thrown from a distance, for recently, when a well was being sunk at Jesetepe, twenty miles from the nearest crater, the same bed was perforated and was found to be more than fifteen inches in thickness. It corresponds to a great period of volcanic activity which appears to have profoundly altered the surface outline of the soil. It is supposed that at this epoch the lake of Nicaragua was finally separated from the ocean.

The eruption, or series of eruptions, which left these traces must have been preceded by a period of repose, during which the waters have deposited a compact layer of clay. At the point where explorations have been tried its thickness does not exceed one foot, but at other points very near it reaches a much greater thickness, ten to twelve feet. This deposit is characterised by numerous fossilised plants and by bones of the mastodon, the only mammalian animal which has been found to be present. Beneath this clay we find anew successive beds of agglomerates, of pumice, of vegetable mould, of sand, and of volcanic rocks. It is in the upper crust of the latter of these deposits, a layer of tufa forty-seven inches in thickness, that human footprints have been found. Below the tufa is a bed of yellow sand of unknown thickness, containing numerous small shells, which the American conchybiologists are disposed to refer to the quaternary epoch.



FOSSILISED HUMAN FOOTPRINT.

The human footprints are numerous, and cross each other in all directions. Some of them are very slight whilst others are deeper, having doubtless been impressed while the soil was still plastic. Some fragments of fossil leaves lie here and there; they have not been exactly determined, but they evidently belong to a flora completely different from that of the clay deposit.

The longest foot-mark measures ten inches; that which we show in the figure (taken from *La Nature*) is only 9½ inches long, 3 inches in width and 4⅓ inches across the toes; judging from these measurements the length of the foot should not exceed 8 inches. We must bear in mind that the earth in its plastic condition would give

way under the weight of the body. The great toe is large and prominent, decidedly longer than the second toe. The depth of the impression is most marked at the anterior part of the foot—the habitual indication of a vigorous pedestrian.

Dr. Flint has found other human foot-marks in different parts of Nicaragua. All testify that this country was peopled at very remote epochs, which, however, cannot be determined. The eruptions, the floods, the upheavals and displacements which they involve in volcanic regions are in such regions both very frequent and very irregular in their duration and their intensity. To this must be added the luxuriant tropical vegetation, which in Nicaragua rapidly destroys all traces of man. As for the mastodon it is in no wise characteristic of any special epoch, since it has survived in America down to historical times. Recently there has been found at Concordia a complete skeleton of this animal in a pool paved with stone slabs. The shells found in the sands underlying the stratum containing the footprints are ascribed to the quaternary epoch. Consequently the footprints themselves cannot belong to an earlier epoch.

CHROMATOPHORES.

TAKE two live trout or speckled gold-fish, similar in size and colour. Have ready two earthenware bowls, one white inside, the other completely blackened with paint. Fill these with water, and put a fish in each. Under the action of light the colour of the fishes will gradually change. After ten minutes or a quarter of an hour a marked difference will be observed, if both the fishes are placed in the same bowl. The fish which has been kept on the dark ground will be visibly darker than the other. The experiment is best made by daylight, but gaslight will do. It is easy to vary the conditions, so as to prove beyond all doubt that change in the amount of light reflected from the bottom produces a rapid and conspicuous change in the colour of the fish. Frogs and shore-fishes will be found to give similar results. The advantage to the fish or frog of this power of accommodation is obvious enough. The animal escapes detection by protective resemblance to its surroundings. Many naturalists have remarked that in the desert nearly all animals are sand-coloured; that many of the animals of polar or alpine districts are white as snow or speckled with white. Some inhabitants of sub-arctic regions change to white as winter comes on. The sloth in the dingy green surroundings of a dense forest assumes a grey-green colour. Flat fishes are usually sand-coloured above, so that looking down upon them we can hardly distinguish them from the sand upon which they lie, but they are white beneath, so that when looked at from below as they flutter to the surface they harmonise very well with the white light pouring down from the sky.

The mechanism of accommodation is very diverse. Sometimes it depends upon the pigment contained in the hair or feathers. The sloth disguises himself by means of a crop of microscopic green algæ, which find a coign of vantage in deep channels sunk in his coarse hair. Aquatic animals usually have recourse to the pigment-cells of the skin as a means of assimilating themselves to the objects around. Any observer, moderately skilled in the use of the microscope, can see for himself the pigment-cells of a frog or a fish. A little bit of the skin must be examined both in surface-view and in section. The cells will be readily made out as blotches of black, yellow, and other colours lying in the skin. They are what are technically called "chromatophores," a kind of connective-tissue corpuscles, straggling masses of protoplasm with wide meshes, and lodging drops of the oily pigment which they secrete. The protoplasm gives evidence of irritability. When stimulated in a particular way, it contracts to a spherical shape, gathering up all the contained pigment into the smallest possible space. Another kind or degree of stimulus causes it to dilate into a stellate figure, with a central blot, and long rays ending in knobs. Hence the pigment, though constant in amount, produces very different effects. If contracted into spherical drops it intercepts very little light; if dilated, it may suffuse the whole surface.

We may next inquire whether the mechanism depends upon the immediate stimulus of the incident light. Do the corpuscles contract or dilate automatically, according to the intensity or amount of the light which falls upon them? A little reflection shows that such a property would be quite useless. It is not the light which falls upon the body, but the light reflected from surrounding objects which has to be matched. Between this reflected light and the pigment-cells the opaque body of the animal is usually interposed, and the cells cannot accommodate themselves to a condition of which they are, so to speak, unaware. Hence the pigment apparatus may be supposed to stand in need of a percipient and regulating mechanism outside itself. Experiment shows that such a mechanism exists in the eye and the cutaneous nerves. If the fish be blinded, or if a certain branch of the tenth pair of nerves be cut, the power of accommodation is immediately lost. The eye judges of the colour of the ground, the central nervous system receives the impression communicated from the eye, and regulates through the cutaneous nerves the behaviour of the pigment-cells. There is every reason to suppose that the action is altogether unconscious and involuntary.

If we call up to our recollection the varying hues of the chamæleon or cuttle-fish, the adaptation of the colours of ticks to the parti-coloured scales of snakes, the splashing and speckling of certain birds'-eggs in imitation of the lime-sprinkled rocks about the sea-side breeding-place, and the infinite varieties of colour which depend not upon pigment but iridescence, we see what a great part protective colouring plays in nature. Changing circumstances and the capricious differences of individual animals furnish an endless series of natural experiments, and every successful experiment is embodied in a permanent modification of the protective mechanism.

THE WHITE LEAD INDUSTRY OF AUSTRIA.—Four different grades of white lead are manufactured in Austria, Kremser white, Venetian white, Hamburg white, and Dutch white. The first bears this name because at some remote period an excellent quality of white lead was manufactured at Krems, an ancient city of Lower Austria, but none has been produced there for at least 150 years; but the best quality white lead still bears the name Kremserweiss. The same is the case with the Venetian white; the name, like Venetian red, has survived, although the industry has been dead for centuries. Kremser white contains a trace only of indigo, Venetian white contains equal parts of lead and baryta, or blanc-fixe, Hamburg white contains one part of lead to two of baryta, while in the Dutch white there are three parts of baryta to one of lead. The raw material is obtained from the lead mines, the most important of which are situated in Villach and Bleiberg, in Carinthia.

General Notes.

Hydrophobia.—From comparative experiments made by M. Pasteur, with every care, it appears that the virus of a rabid cat, like that of the wolf, is much stronger than that of the dog. An unsolved question is whether wild animals of the canine family, wolves, jackals, and pariah dogs, do not recover spontaneously from rabies?

Alum Stone and Sulphur in New South Wales.—According to Dr. R. W. Emerson Maciva (*Chemical News*), Mr. S. H. Cox found in the county of Gloucester a vast extent of alunite, which, when roasted and dissolved, yields crystals of alum absolutely free from iron. Large deposits of native sulphur are found in the same district.

Alleged Danger in Tinned Meats.—MM. Ungar and Bodlander have been studying the poisonous action of the salts of tin. They contend that this metal may be, to some extent, attacked either by the juices of fruits or by the tartaric acid (?), saltpetre or common salt added as antiseptics. They admit, however, that tin is less readily attacked by acids and acid salts than are lead and copper.

Australian Rubies.—According to *Invention*, rubies are now being received from the Una Company, in Adelaide, which are described as exceedingly fine. Stones from the Hale River have been spoken of as very choice. The Maude River, also, is likely to turn out extremely rich in precious stones. The other day over 60,000 stones were received in Adelaide from Mr. Oliver, and deposited in one of the banks there.

To Preserve Wood from Decay.—A plan recently introduced into Belgium for preserving wood from decay produced by the atmosphere, water, etc., is to fill the pores with liquid gutta-percha, which is said to perfectly preserve it from moisture and the action of the sun. The solid gutta-percha is liquefied by mixing it with paraffin in proportion to about two-thirds of gutta-percha to one-third of paraffin; the mixture is then subjected to the action of heat, and the gutta-percha becomes sufficiently liquid to be easily introduced into the pores of the wood. The gutta-percha liquefied by this process hardens in the pores of wood as it becomes cold.

Picrocarmin for the Microscope.—The following, according to the *Magazine of Pharmacy*, is an improved method of preparing picrocarmin for microscopical purposes:—About half a gramme of carmine is dissolved in 100 cubic centimetres of water containing 5 cc. of a 1 per cent. solution of soda. The liquid is then boiled, filtered, and made up again to 100 cc. by addition of distilled water. In order to neutralise the solution, it is mixed with an equal volume of water, and a 1 per cent. solution of picric acid is then added. This at first causes a turbidity to appear, but it subsequently disappears. If not, it indicates that the point of neutralisation has been overstepped.

New Chemical Formulæ.—The vapour density of ferric chloride has been determined by Dr. Grunewald and Dr. Victor Meyer, and their results have conclusively shown that its formula is $FeCl_3$, not Fe_2Cl_6. This agrees with the formulæ $AlCl_3$ and $InCl_3$, which have been proved by Nilson and Pettersson, and V. and C. Meyer, respectively, to be correct for the chlorides of aluminium and indium, but it does not allow us any longer to regard iron as tetrad. Professors Nilson and Pettersson are said to be engaged in experiments by which they hope to determine the vapour density of ferrous chloride, and if they are successful we shall possess data for a re-adjustment of our views on this important point.

How a Blizzard Kills.—A curious observation has been made from a study of the condition in which the victims of the blizzard which recently swept over Indiana and a wide tract of the North American continent were found. It seems that death was due not to the cold, but to suffocation; the unparalleled suddenness and extent of the fall of temperature converted the snow into ice crystals, which were ground by the gale to a fine, dry ice dust, and the air was thus rendered quite unfit for respiration. This would make the effect of the blizzard exactly analogous to that of the dreaded sand storms of the Sahara. It is stated that the number of deaths, so far from being exaggerated, has been a good deal understated by the local newspapers.—*British Medical Journal.*

The Colour of Lakes.—A contemporary asks, "Why among the Swiss lakes is Geneva blue with a greenish tint? Why is the water of Zurich green, that of Morat brown, and that of Bret greenish-brown?" To this it is replied that the colour of a lake has been found to depend not on solids held in suspension, but on the matter existing in solution. This is said to have been ascertained from the experiments of M. Forel on the Swiss waters. But some years ago Mr. Crookes, in conjunction with Drs. Odling and Tidy, found that the colour of water free from organic impurities is a fine pale blue and in proportion as such pollution increases the water becomes first colourless and then yellowish. The peculiar pale rose-tint observed in the Ganges has not yet been explained.

New Process for Preserving Timber.—Works for preserving wood by a new process known as the zinc-gypsum process have been erected at St. Louis, and are conducted by a company styled the American Wood Preserving Company. The wood is prepared by impregnating it with a solution of chloride of zinc and sulphate of lime. It is placed in large metal cylinders, and steam introduced until the wood is heated to the boiling point, thereby destroying the fermentible elements and the sap, after which the steam is blown off, and the solution above named is let in and heated by means of steam coils, being left to operate on the wood under a pressure of 60 lb. to 100 lb. until impregnation is complete. One cubic foot of white pine or Cypress will absorb from 6 lb. to 7 lb. of the solution.

The Co-efficient of Proportionality in Radiant Heat.—M. L. Godard (*Comptes Rendus*), by studying the diffusion of heat by substances of a dead colour, has been led to undertake the spectro-photometric analysis of these substances. For each pigment he takes as a characteristic the tone, that is the wave-length corresponding to the maximum of the curve constructed on taking

as abscissæ the wave-lengths, and as ordinates the quantities of light diffused by the pigment in different regions of the spectrum. He finds that if we determine the diffusive power of white lead for different sources of heat, we obtain the diffusive powers of other dead pigments on multiplying this diffusive power of white lead by constant coefficients, determined once for all, or which he calls coefficients of proportionality.

The Bore Hole at Seaton Carew. — The boring which is now being executed by diamond-drill process, under the superintendence of Mr. W. J. Bird, mining engineer, has now reached 1,300 feet, and is still in the magnesian limestone, which was first reached at 520 feet from the surface. It is contemplated to carry on the boring until the magnesian limestone is pierced, and it is ascertained whether the coal measures exist beneath it or not. The salt bed does not exist at Seaton Carew, but, very curiously, a feeder of strong brine has been tapped at about 1,150 feet depth, which is nearly saturated, being at least 21 per cent. strong. It is intended to ascertain the extent and permanence of this feeder, since if these are proved, it will answer much better than the salt bed, there being no fear of surface subsidence. The brine feeder is probably derived from the salt bed on the south.

A New Lubricant.—Messrs. Born Brothers, of Ilversgehofen, near Erfurt, are introducing a kind of mustard oil which has been found to be exceedingly suitable for lubricating purposes, and which may be used to advantage where no other lubricator can prevent the heating of bearings. It has proved especially suitable in those cases where either speed or pressure is great, as for instance in turbines, and rolling and crushing mills. Comparison tests made with the best olive oil, and a mixture of olive oil and mineral oil showed that, compared with olive oil the lubricating value of mustard oil is as 263 to 168, and as compared with a mixture of olive and mineral oil the lubricating value is as 263 to 125. A further advantage of mustard oil is its low freezing point. This oil solidifies at a temperature of from 7°C. to 8°C. below zero, so that even in cold weather it still retains its lubricating value, while olive oil, as is known, solidifies at a temperature slightly above zero.

New Researches on the Solar Spectrum.—Messrs. Hutchins and Holden, of the University of Cambridge, Massachussetts, have examined the solar spectrum with an excellent Rowland refraction-grating, and they have re-measured and compared the lines of a number of terrestrial substances whose presence in the sun has not yet been decisively shown. Upon the whole, their researches have not led to definite results, so that it is still doubtful whether lead, tin, silver, cerium, molybdenum, uranium, and vanadium exist in the sun. Hitherto, however, it has been an open question, whether the lines of platinum coincide with any of those in the solar spectrum, and in this respect the researches of the above-mentioned physicists lead to the important result, that out of sixty-four of the lines of the platinum spectrum situated between the wave-lengths 4,250 and 4,950, sixteen have been detected in the solar spectrum. Hence we may conclude with great probability that platinum ranks among the elements present in the sun's atmosphere.

Milk and Tubercular Disease. — The *Scotsman* recently had an exceedingly able article on milk as a possible channel for the introduction of tubercular disease along with scarlatina and typhoid fever into the human system. The writer points out the unsanitary condition to which cattle are subject, both as regards their housing and their diet. He shows that cow-houses, even in country places, contain "stenches strong enough to kill any life, and perspiration streaming down the walls." The "city life" of a cow, before it succumbs to the unnatural condition in which it is placed, is from eight to ten months. As to the food, he says, "It is well known that eating sewage grass causes dysentery. Then how about the Craigentinny meadows which furnish the staple food for the cow-feeders of Edinburgh? Are they not a standing menace to the health of this city, notwithstanding or rather because of the free and rapid absorption of streams of sewage? Every year the strength of that sewage is increasing and the soil becoming more and more sodden."

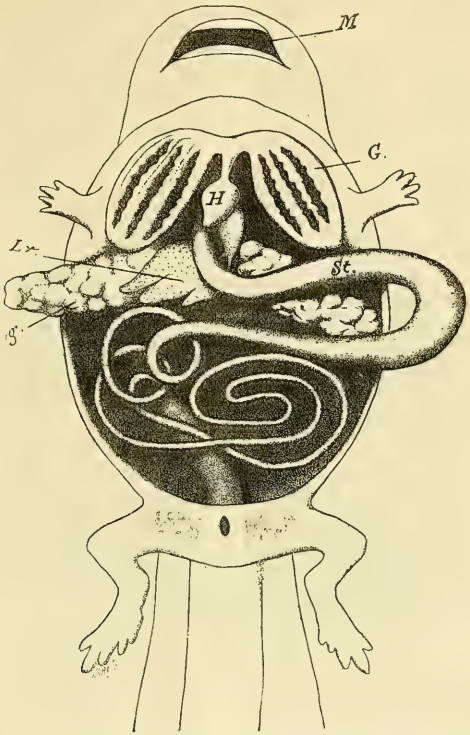
Telephonic Bullet Probe.—According to the *Medical Press*, Dr. Gardner, of New York, has devised a probe which enables the presence of a bullet to be accurately defined in whatever part of the body it may be situated, and its extraction thus rendered easy of performance. The instrument consists of a vulcanite frame adapted to the ear, and secured by a spring band encircling the head. In this frame is fixed a thin vibrating tympanum-disc, at a short distance from which a bar of soft iron is fixed, the latter being surrounded by a coil of wire, the terminals of which communicate directly with insulated wires about four feet long. One of these ends in a steel cone, which may be held in the mouth, rectum, moistened hand, etc., of the patient, while the other terminates in a fine steel wire or other probe, which may either be plunged into the body in search of bullets where suspected to be present, or introduced into sinuses or other openings. Immediately on its coming into contact with such a metallic body a current is generated in the circuit so completed, and a distinctly audible "click" is apparent to the operator's ear armed with the telephone.

Curious Physiological Observation.—It is known that the three semi-circular canals of the internal ear serve probably to give us the notion of equilibrium and of movement. But, says M. Eugene Varenne, of Paris (*La Nature*), it is to be remarked that these canals are arranged so that each answers to one of the co-ordinates of space. Experiment shows that if an animal be wounded in one of these canals, it experiences a subjective sensation of rotation which induces it to turn in the opposite direction in order to re-establish its equilibrium. Flourens has proved that the section of two symmetric semi-circular canals induces oscillations of the head, and movements of the entire body in the plane of the canals injured. All these facts tend to prove that the semi-circular canals are the peripheric organs of the sense of space. In confirmation of this fact, it may be noted that if whilst walking we bend the head strongly to the right and then back to the left, causing it to oscillate quickly from the right to the left after a very short time (eight to ten seconds), the body of the experimentalist is suddenly thrown to the left. If, on the contrary, the head is first inclined to the left, the body will be thrown to the right.

TADPOLES.

WE said something lately (SCIENTIFIC NEWS, page 269) about a fowl's egg and its development, and now give for comparison a sketch of another type. Workers at natural history may be interested in a few plain hints as to what is to be made out in the eggs of a frog and the tadpoles which they produce.

The eggs of the frog are laid in March, and among the first signs of spring are the bunches of frog-spawn floating in the ditches. Every such bunch consists of some hundreds of black eggs, each surrounded by its own envelope of transparent slime. The black spot is the essential part of the egg, and the only part present in the ovary of the female. The outer envelope is deposited whilst the egg is travelling down the oviduct, and is therefore similar in the manner of its formation to the white of the fowl's egg. At the moment when the egg gains the water, this envelope is scanty, but it soon swells by the absorption of water, and comes to greatly exceed the egg itself in bulk. What is the purpose of this glairy envelope? First of all, it is useful to space the eggs, which need, above all things, light and air. If they were packed closely, the inner ones would probably never develop at all; but being gently pushed apart by the swelling of the albuminous covering, no egg intercepts too much the light; and water containing dissolved air can permeate the mass. Secondly, the elastic and slippery investment renders the egg too smooth to be picked up by birds and predatory insects, which would gladly devour the floating spawn. Try to grasp a mass for yourself. As your fingers vainly close upon the slimy stuff, you learn how effectually the eggs are protected from bills and jaws. Lastly, the albuminous covering is a defence against parasitic moulds. There are many aquatic moulds which fasten readily upon animal matter and destroy it. They cannot touch the frog's egg, protected by its smooth and watery coat, for this secretion contains some preservative of unknown kind which absolutely secures it from all the microscopic organisms which engender mould and putrefaction. The experiment has been tried of gently removing the albuminous covering. All the eggs so treated were speedily attacked by the aquatic moulds and perished. The envelope of the frog's egg is not nutritive, like the white of the fowl's egg. It is left untouched after the tadpoles have hatched out, and they only find it worth eating when it has become overgrown with green cells, which usually happens after a few weeks.



TADPOLE WITH LONG TAIL, HIND-LIMBS WELL DEVELOPED, FORE-LIMBS NOT EXTERNALLY VISIBLE. *M*, MOUTH; *H*, HEART (VENTRICLE); *G*, INTERNAL GILL; *St*, STOMACH; *Lv*, LIVER; *Lg*, LUNG.

What can the naturalist untrained to the methods of

the laboratory do to penetrate the secret changes which turn these black specks into wriggling tadpoles? The thorough study of the development of the tadpole is, we must admit, far from easy; but some of the most interesting points can be made out even by a novice. If a mass of spawn just laid can be captured, the segmentation of the eggs may be observed. The surest way is to catch and keep a female with an attached male; but close observation from day to day of a particular pond or ditch will enable us to find a bunch of newly-laid spawn. Place a few of the eggs in a watch-glass filled with water and blackened on the outside by a coat of varnish. The cleavage of the egg into two, four, eight, and more cells may then be observed from hour to hour with a simple lens.

Any child who keeps a glass jar with frog-spawn in it can see the slow change of the round egg into the tailed larva; but the careful study of the very young tadpole requires some knowledge, besides skill in the use of instruments. We pass on to a later stage, where even the untrained observer can find something to do. In early summer active tadpoles, with long tails and a tiny rudiment of hind legs, can easily be found. Capture some of these, and kill them by placing in hot water, about as hot as the hand can bear. The little creatures, only about an inch long and very tender, have to be dissected, and this requires some management. But first go over the outside of the body with a lens. Notice the tail, the hind legs, the rounded and swollen body, the mouth and the eyes. Then secure the tadpole in a convenient position—that is, back downwards.

A pomatum-pot or any similar vessel must be filled, while hot, with solid paraffin, obtained by melting a bit of candle. When the paraffin is hard, take up the tadpole with the point of a knife, dry it for a moment with blotting paper, and lower it upon a part of the surface of the wax which has been melted for a moment with a hot rod or wire. With some dexterity, but probably not at the very first trial, the tadpole can be secured in this way. If alcohol is at hand, it is a good plan to dip the tadpole in it before drying and mounting, as a trace of alcohol does not repel the melted wax so effectually as water. The next thing is to remove the skin from the exposed surface of the body. A pair of needles in clever hands can be made to do the work, but insect-forceps and fine, sharp scissors are much better. The pomatum-pot should be placed in a larger dish, and water added till the tadpole is just covered. Gradually cut or tear open the body, and then study with a lens the parts exposed. Our figure will show what is to be seen in a successful preparation. Among the points to be made out are the fore limbs, which were not visible before dissection, being concealed beneath a fold of skin and muscle (the opercular fold), from which they protrude only in a late stage of tadpole life. The gills in this stage are internal only, the external gills seen in very young tadpoles having been absorbed. It is to be remarked that lungs co-exist with these gills; but they are destined for future use only, and have never yet been filled with air. The long intestine is well-suited to the vegetarian diet of the tadpole. As the carnivorous appetite grows, the intestine becomes shorter and simpler. It is of interest to observe the reversal of the complicated spiral into which the closely-wound intestine is thrown. The arrangement is often compared to a watch-spring, and has been so figured. (See, for example, Owen's "Comp. Anat. of Vertebrates," vol. i., p. 624.) A description so imperfect passes over a curious mechanical adaptation. The tadpole's intestine is at first straight, and no longer than the body. Then it gradually lengthens, and coming greatly to exceed the length of the body, must be thrown into many coils. It is well known that to wind in a regular and continuous spiral a tube which is attached at both ends would twist and strain its walls; but, by reversing the spiral during half of its extent, the twist is taken off. Our readers will perhaps recollect in this connection Mr. Darwin's account of the tendril of the bryony.

If the mouth be dissected, we discover the horny plates which enable the tadpole to crush the green weeds upon which it lives. In front are the plates which form the beak. The upper plate is the larger, and comes down in front of the lower. Behind these are rows of smaller horny teeth on the sides of the mouth. The edges of the lips are divided into many-rounded papilla. The horny teeth completely disappear during transformation, and are succeeded by calcified teeth with a quite different arrangement.

MAKING PIG IRON WITH GAS.

THE *American Manufacturer* says that Mr. Jacob T. Wainwright, a well-known metallurgical engineer, of Pittsburg, Pa., has succeeded in making pig iron with natural gas as fuel. His furnace differs from the ordinary blast-furnace in this, that, while dispensing with coke, it has overcome the great difficulty noted in connection with other experiments in gas-furnaces, by a mechanical device for supporting the burden. This device consists of a series of pipes covered with fire-clay tiles, and at the same time ventilating the pipes with a current of air. A combustion-chamber is also connected with the furnace, which reduces the amount of gas needed to produce the required heat, and also prevents the chilling of the furnace, which has been a great obstacle to the success of other experiments.

In the new furnace the ordinary cupola blower is used, and the gas and air are introduced in a very simple manner into the combustion-chamber in a separate pipe. The current for cooling the tubes, already mentioned, is supplied from the same air blast, and from thence may be utilised in the furnace. Ordinary cupolas may be easily altered, so as to do the required work, by adding the combustion-chamber and the protecting tubes for supporting the burden.

The tests were made at the iron and lead works of William G. Price, on Price Street, where the inventor had the hearty co-operation of the manager, Mr. David Carlin. Mr. Carlin says that the furnace worked rapidly, and that its success is no longer doubtful.

THE COBRA POISON.—In spite of numerous investigations carried on in India and elsewhere, there still exists the greatest uncertainty as regards the chemical nature of the venom of the cobra. Until this is known, it will, of course, be almost impossible to find an antidote. According to the latest hypothesis put forth by R. N. Wolfenden, the poisonous ingredient belongs to the proteine group of bodies; he finds in it globuline, syntonine, and serum-albumen. It is a curious fact that the chemical nature of *animal* poisons (spiders, snakes, fish, etc.) has not yet been determined in any case.—*Monthly Magazine of Pharmacy.*

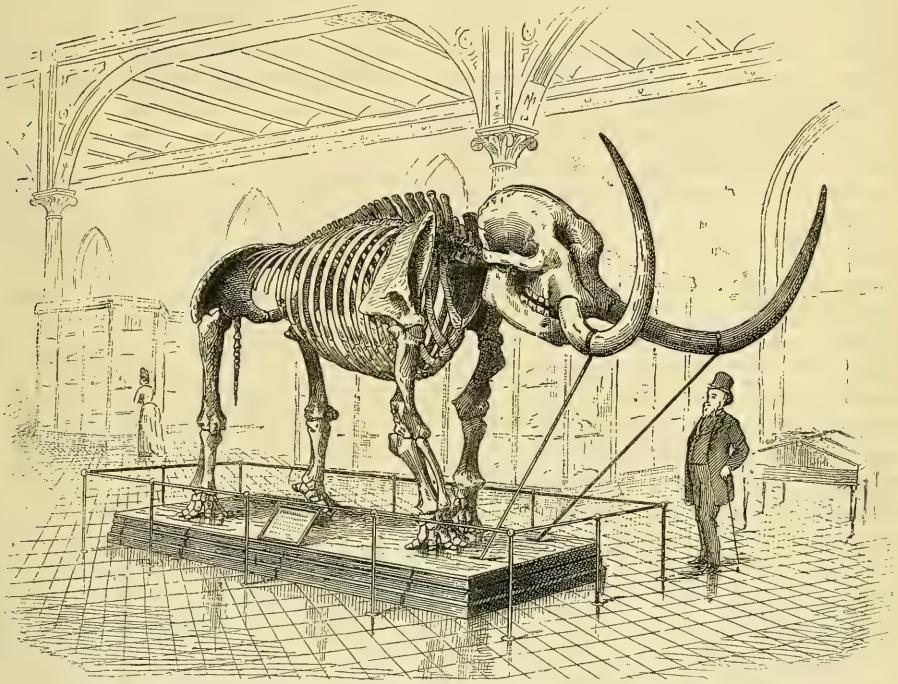
Natural History.

THE MASTODON GIGANTEUS.

The mastodon, that great fossil mammal, allied somewhat nearly to the elephant, has become, perhaps, more familiar to the public than any other of the numerous great creatures which once lived in the United States. This familiarity came about through the frequent discovery of well-preserved skeletons of the mastodon.

In nearly every State west of New England portions of this creature have been disinterred. And every year there are several found, more or less in a state of complete preservation. The circumstance of several examples having about them evidences of man's work is extremely interesting. On one account it brings the date, though greatly indefinite, to man's existence. We are, therefore, able to say, man and mastodon are contemporaneous; but the date is obscure. We have not determined what sort of man made those stone arrowheads which struck the life out from the great carcases and lie among their remains. We have not a knowledge of what sort of man made the charcoal which was found lying among the partly burnt bones of a mastodon near the Mississippi River; but we do know that some man made the arrowheads. And we know also that no other than man is capable of making charcoal, or even to make fire by which it is formed. We are then able to say that the mastodon, like the fossil elephant of America, lived in the period allotted to man, while the marvellous great skeletons of extinct mammals which have also been found in the western "Bad Lands," are of more ancient date, being of the Miocene and other ancient deposits.

The most perfect, and also the most remarkable, as to size and interesting developments, is the skeleton of a mastodon now mounted in the Geological Hall of the American Museum of Natural History, in Central Park. This example, of which our illustration is a correct picture, was found embedded in a peaty material in the town of Salisbury Mills, near Newburg, N. Y. At the time of the discovery of these bones, in 1877, the locality was cultivated as a potato field. It was, fifty years since, a pond-hole of considerable size. In digging a ditch about 20 inches deep, in order to drain the pond, the workmen, at the depth of 14 inches, came upon a hard substance, which proved to be one of the long bones of the mastodon.



Skeleton of the Mastodon Giganteus, in the American Museum of Natural History.

Professor Whitfield, of the geological department of the American Museum, in company with Major Brooks, of Newburg, visited the place of discovery. He found the situation to be "a swamp, bordered on the side nearest the position of the skeleton, by a low hill of boulder clay, a hard, blue clay, mixed with gravel, which slopes down and passes under the peat of the swamp, and forms the original bottom of the pond. Every evidence, as has

usually been noticed in other examples, was in proof of the animal's extinction by miring."

This skeleton is regarded as the most perfect of mounted ones known. This is a gratifying circumstance, as the greater number which have been removed from their burial places have proved to be greatly decomposed. Often the upper side of the great creature is much decayed, owing to the nearness of the bones to the surface. The only skeleton now in museums which compares to the present one in perfection is that famous one—the Dr. Warren example—which was found in 1845, near Newburg, N. Y.

In the present specimen the tusks were so injured that two others were substituted. The jaw is also exhibited with the skeleton, and shows the two remarkable undertusks which are known to exist at an early age. These lower jaw tusks are obsolescent, being only about six inches in length. In most mandibles of the mastodon which are extant there is more or less of remaining alveolar development, which shows that at some period the creature had the mandible tusks fully grown.

The great tusks which are used in the skeleton to replace the decayed ones which were found with it are from an example found in Hoopstown, Illinois.

The dimensions of this skeleton are as follows :

Extreme length	18 feet.
Exclusive of tusks	14 ,,
Width of pelvis	5 ,,

It is the purpose of the American Museum trustees to mount alongside this mastodon the skeleton of the great elephant which Mr. Barnum lost by the late fire. This will afford an opportunity to compare the bones of the largest of Asiatic elephants with a large mastodon. It is well known that the African elephant has some near affinities to the latter, and in the near future a good example of that species will be added to the group.

The elephant, as contrasted with the mastodon, shows at once a greater height and shorter body. This is very considerable. Perhaps the next important comparison is in the aspect of the fore limbs. In the elephant the fore limbs are columnar, as are the hind limbs. In the mastodon there is a decided aspect more or less of prehensile capacity (as it were), that is, the latter have the fore feet approaching the plantigrade in aspect, and the limbs correspondingly adapted for pronation and the opposite. Of course this is slight, but shows the difference in probable habits. The fore limbs of the mastodon, with such development, we should expect, would be able to be thrown over low foliage or brushwood, and a crushing effected by the somewhat expanded manus. No such movement could be effected by Elephas. Although there is a general resemblance in the two great creatures, and especially as both have similar nasal developments, a near view of both together shows many differences in form.

The teeth are usually spoken of as constituting strong characters. The Molars of the mammoth with projecting, strong tubercular ridges, resemble the teats of a cow. The Greek *mastos*, a breast, being the root ; hence *mastodon, mastos* and *odontos*, breast-toothed, or nipple-toothed.

The latter-named kind of teeth are manifestly for crushing the coarse vegetable matter, and this corresponds to the probable uses of the fore limbs in crushing down shrubbery. The elephant grinds his food as a horse does. Both creatures, however, have the proboscis, and probably use that member similarly.

The first notice of the finding of the remains of a mastodon is found in the Transactions of the Royal Society of London, in the year 1714. Here is a short article in which it is stated that a letter from Cotton Mather, of Boston, New England, to Dr. John Woodward, gives a description of some large bones which were found in 1705 at Claverack, in New York State, near Albany. Nothing further appeared until 1740, when De Longueil, a French traveller, discovered some bones at the Salt Lick, in Ohio.

To Cuvier we are indebted for the first intelligent accounts. Until 1801, little was known of the perfect skeleton. At that time, Mr. Peale, of Philadelphia, obtained and set up in his museum an example which was found in Orange county, N. Y. In 1840, Mr Koch found one on the banks of the Missouri River. It is now in the British Museum. Some specimens, single bones, have been taken up in Connecticut, along the Farmington River. The great river which separates New England from New York seems to have been a partial barrier to the passage east of the great beasts.—*Scientific America.*

A Plague of Rats.—A recent number of the *Pekin Gazette* contains a memorial to the Emperor from the Governor of Uliassutai stating that, owing to the appearance of swarms of rats, it has been found necessary to alter the routes of the Government courier service in three of the postal stations in the Khalkha region in Outer Mongolia. For two years past the pasturage of the districts in question has suffered severely from the ravages of these vermin, and last year nearly every blade of grass was eaten up. The whole country has been honeycombed with their burrows, the horses and camels are in a famishing state, and there is no means of keeping them alive. The burrows are a source of great danger to the mounted couriers, and the want of forage renders it impossible to maintain a supply of animals for the service.

The Barking Frog.—Mr. F. W. Styan, writing in the *Field*, describes the "barking frog" of China, which he has had the opportunity of observing. He says :—"It is of very large size, upper parts olive green with purplish brown markings, under parts white, turning to yellow towards the sides, with rich purple blotches, the throat being entirely marbled with them. The surface of the upper part is rough, but in the specimens I have handled I could find no traces of the spines or roughness on the underparts mentioned by Père David. Its peculiarity, however, lies in its voice, which is precisely like the deep, hoarse bark of a dog—a big dog like a mastiff. I will undertake to say that nineteen people out of twenty, hearing in the still of evening its deep 'Wough, wough, wough, wough,' uttered with a slight rising inflection, will never suspect it to be anything but a large dog at some distance away. I was deceived by it myself, and did not find out the real source of the bark for a long time, and I have seen many others taken in by it. One party actually sallied out one day, armed with revolvers, and followed by natives carrying long bamboos, to drive the supposed wild beast out of a hole among the rocks, where it appeared to have taken shelter, and whence it declined to be dislodged. For my own part I was only undeceived at last by hearing one strike up within a few feet in a half-hearted kind of way, more of a croak than a bark, and yet sufficiently like the real full blown note to

be recognisable. They bark mostly by night, like all frogs, and when heard by day, it is usually in this half croaking manner."

English Trout Eggs for India.—The *Fishing Gazette* states that Mr. W. T. Silk, of Burleigh-park Fishery, Stamford, recently shipped to India for Major Hodgson 10,000 English trout eggs, and hopes from these eggs to stock some streams in the Neilgherry hills, in the South of India.

A Great Auk's Egg.—On the 12th March, Mr. Stevens, of King Street, Covent Garden, sold a very fine egg of the great auk for £225. It had been in the possession of the late owner since 1851, when it was purchased for £18. This is the highest price ever paid for an egg, and is an advance of £57 on the sum paid for a great auk's egg of which we recorded the sale last December. We gave a description of this bird on page 59 of this volume.

Weight and Dimensions of a Tiger.—Mr. F. A. Shillingford gives, in the *Calcutta Englishman*, the following particulars concerning a tiger recently killed at Purneah: Weight, 520½ lbs.; length from tip of nose to root of tail, 6 feet 5 inches; height at shoulder, 3 feet 9 inches. This record is of some value, as sportsmen generally include the tail in the measurement of the animal; and as the length of this member bears no fixed proportion to the size of the tiger, the figures are useless.

Abnormal Colouration in a Cat.—Some years ago the generalisation was suggested that, if any black colour was found at all in feline animals, it would certainly occur at the tips of the tail. In dogs, on the contrary, the tip of the tail was alleged to be always white, if that colour occurred in the animal's coat at all. Last summer I happened to see in Hatton Garden a singular exception to the former rule in the shape of a glossy black tom, with the tip of his tail a pure white for about two inches.—J. W. S.

Variation in the Edelweiss.—According to the *Independent Statesman*, of Concord, the edelweiss, when transplanted from the Alps to the mountains of Upper Austria, bears red flowers instead of blossoms of its ordinary greyish-white. This, however, we cannot, like our contemporary, regard as "transformation into a new species," to which very much more would belong than a change in the colour of the flowers. Has the edelweiss of New Zealand a different colour from that of Switzerland?

The "Dicky-Bird Society."—We are glad to learn from Mr. H. Kerr (*Newcastle Weekly Chronicle*) that this strangely-named society is meeting with great success. No fewer than 148,000 children have pledged themselves to refrain from and discourage bird-nesting, bird-catching, etc. Meantime the Selborne Society, now 1,160 strong, is combatting the evil practice of using birds or parts of birds for millinery and dressmaking purposes, and in America the Audubon Society is working on the same lines. We hope that public opinion will soon be sufficiently enlightened to allow of the Legislative prohibition of the importation of hummingbirds, trogons, birds of paradise, etc., for such shameful purposes.

MODERN PHOTOGRAPHIC ENGRAVING AND PRINTING.—I.

A Paper by Mr. George S. Waterlow, read at the Conference of the Camera Club.

The subject of the modern application of photography to the art of engraving and printing is one of stupendous interest to all communities, of immense value to future generations, and teems with interesting details. I cannot but feel that within the compass of this short paper which I have the honour to place before you this evening, it is not possible or desirable that I should attempt any historical account of the various researches and experiments which at the present time place us in possession of the means of illustrating by practical and easy methods every subject of art, life, and nature, methods but vaguely dreamed of a generation ago, even by the most sanguine enthusiasts.

Neither should I endeavour to criticise the merits of specific processes or the busy researches themselves, but I am here simply to describe to you as concisely as possible some of the means by which to-day we may produce illustrations of every description through the powerful agency of the camera.

First, I will take the names of some of the various methods, and then describe the practical working of each as plainly as I can, avoiding the use of technical terms.

Modern photographic engraving and printing may be divided into four heads:—

1 *Typographic blocks*, which are etched in relief, and printed from the surface in an ordinary printing-press.

2. *Plates*, which are etched in intaglio, and printed from the depth, as in the case of an engraved copper plate.

3. *Woodbury blocks*, which are impressed with an intaglio image by a gelatine relief under great pressure, and printed from by a special press.

4. *Collotype or Albertype plates*, *i.e.*, a surface of gelatine on glass or metal, which has been sensitised, acted upon by light through a negative, and is printed from in a hand or steam-printing press.

The most important of the many photographic methods now before the world for mechanically producing prints on paper in the printing-press is that which is popularly named photo-zincography, and is the first referred to on my list.

Before proceeding to a description of the working of this useful process, I might explain, for the benefit of the tyro, that nearly all the results obtained by these processes are founded on the simple fact that gelatine, in the presence of salts of chromium, is rendered insoluble in exact proportion to the amount of light allowed to fall upon its surface. In this peculiar property of the organic substances previously soluble in water, as in the case of gelatine, lies the whole secret of nearly every photo-mechanical process, and in its various modifications lie the initiatory stages of all the different categories just mentioned to you.

I will briefly explain this action. Suppose I dissolve ten grains of gelatine in an ounce of water, and add ten grains of bichromate of potash ($K_2Cr_2O_7$), then coat a sheet of smooth writing-paper with the mixture and dry it in the dark. On now exposing this piece of prepared paper under a negative of a drawing in lines for, say, ten minutes in sunlight, I obtain a faint image or print of

of the drawing in insoluble gelatine, because wherever the light has penetrated the clear parts or lines of the negative it has, through the addition of the bichromate of potash so oxidised and changed the nature of the gelatine that it cannot again be dissolved even in hot water. But there is yet another valuable property to be mentioned in connection with this oxidised gelatine, and that is its capability of taking printing-ink. Suppose I take this exposed piece of gelatinised paper, acted on by light as mentioned, and soak it for a few minutes in cold water, then roughly drying it with blotting-paper, lay it on a flat board, and, taking a roller charged with printers' ink, pass it gently over two or three times, I shall find that the exposed lines will greedily take ink from the roller, whilst the unexposed or white parts will refuse the slightest particle. I shall now have a facsimile copy of the lines of my negative in printers' ink on the gelatinised piece of paper, and if the ink I used were what is known as transfer ink, the inked piece of paper would be a photo-litho transfer, and ready as soon as dry for laying down upon a lithographic stone for printing from in the ordinary way, or, if desired, a plate of zinc might be substituted for the lithographic stone, and by passing the zinc plate through a press in contact with the transfer, the greasy ink would leave the gelatine and attach itself to the zinc, and giving a plate ready for the photo-zinc etcher to make into a typographic block.

Having thus roughly sketched the general principle of the foundation of nearly all photo-mechanical printing, I will briefly discuss the processes referred to, and endeavour to describe the working.

As I remarked, the most important process, owing to its simplicity and cheapness, is that of photo-zinc etched blocks for ordinary typographic printing. I can, of course, only simply state the generally employed method of producing these blocks, and slightly touch upon the other subjects within the limits of this paper. For exact formulæ and details for successfully working any one of these processes, I must refer you to specialists who make these arts a life study, and to the few works at present published on the subjects.

First, then, the operations of etching a type block, say from a line drawing.

The drawing intended for reproduction is pinned on a board and placed squarely before a copying-camera in a good even light. The lens used for this purpose must be capable of giving a perfectly sharp picture right up to the edges, and must be of the class called rectilinear, *i.e.*, giving straight lines. The picture is then accurately focussed and brought to the required size; a plate is prepared in the dark room by the collodion process, which is then exposed in the camera for the proper time and developed in the ordinary way; after development, the plate is fixed and strongly intensified in order to render the white portions of the drawing as opaque as possible. On looking through a properly-treated negative or this kind it will be seen that the parts representing the lines and black portions of the drawing are clear glass, and the whites representing the paper a dense black. The negative after drying is ready for the next operation, *i.e.*, printing upon zinc. This is done in several ways. One method will, however, be sufficient for the purpose here. I obtain a piece of the bichromatised gelatine paper previously mentioned, and place it on the face of the negative in a printing-frame. This is exposed to sunlight (if there be any) or daylight for a period varying from five to thirty minutes, according to the strength of the light. This exposed piece of paper is then covered all over with a thin coating of printing-ink, and wetted in a bath of cold water. In a few minutes the ink leaves the white or protected parts of the paper, remaining only on the lines where the light has passed through the negative and affected the gelatine. We now have a transcript of the drawing in printing-ink on a paper which, as soon as dry, is ready for laying down on a piece of perfectly clean zinc, and passing through a press. The effect and purpose of passing this cleaned sheet of zinc through the press in contact with the picture on the gelatine-paper is this: owing to the stronger attraction of the greasy ink for the clean metal than for the gelatine, it leaves its original support and attaches itself strongly to the zinc, giving a beautifully sharp and clean impression of our original drawing in greasy ink on the surface of the zinc. The zinc plate is next damped and carefully rolled up with a roller charged with more printing-ink, and the image is thus made strong enough to resist the first etching. This etching is done in a shallow bath, which is so arranged that it can be rocked to and fro. For the first etching, a very weak solution of nitric acid and water is used; the plate is placed with this acid solution in the bath, and steadily rocked for five or ten minutes. The plate is then taken out, washed, and again inked; then it is dusted over with powdered resin, which sticks to the ink on the plate; after this the plate is heated until the ink and resin on the lines melt together and form a strong acid-resisting varnish over all the work. The plate is again put into the acid etching bath and further etched; these operations are repeated five or six times, until the zinc of the unprotected or white part of the picture is etched deep enough to allow the lines to be printed clean in a press, like ordinary type or an engraved wood-block. I ought, perhaps, to explain that between each etching the plate is thoroughly inked, and that this ink is melted down the sides of the line, so as to protect the sides as well as the top from the action of the acid; were this neglected, the acid would soon eat out the lines from below. The greatest skill and care is, therefore, necessary in this work, especially so in the case of some of the exquisitely fine blocks which are etched for some art publications.

(To be continued.)

IRIDESCENT CLOUDS.

MR. J. C. McCONNEL, according to the *Popular Science Monthly*, has studied the phenomena of iridescent clouds at St. Moritz, in Switzerland, where they are very common in winter, occurring usually whenever there are scattered clouds near the sun. Within a circle of about 2° radius the clouds are whitish, faintly tinged with blue. This space is surrounded by a ring of yellow or orange. The region of most vivid hues is comprised between 3° and 7°, and the most striking tints are purple, orange, green, and red, distributed in irregular patches over the thinner parts of the clouds. Beyond this region the only colours visible are green and red, becoming fainter as the distance from the sun increases. He supposes these colours to be the result of diffraction of light by fine particles of ice.

WASTE LAND IN INDIA.—In India ten million acres of good land have never been cultivated, and 120 million acres are returned as wastes.

Reviews.

Astronomy for Amateurs: a Practical Manual of Telescopic Research in all Latitudes adapted to the Powers of Moderate Instruments. Edited by John A. Westwood Oliver. London: Longmans, Green, and Co.

Scattered through the world are numerous people who possess telescopes of more or less power, and most of these instruments must from time to time be employed for star-gazing; but very little work of importance is done with them. A few enthusiastic observers have made themselves a world-wide reputation by devoting special attention to some branch of astronomy, but by far the greater number of amateurs content themselves with occasional peeps at planets, nebulae, etc., and make no endeavour to carry on a special line of research. Probably this supiness is not due to lack of enthusiasm, but to the fact that they do not know what to do, or what requires to be done. We welcome, therefore, this work which Mr. Oliver has edited; it discusses what has been done in various branches of astronomy, and indicates the points on which further information is required, and which can be studied with advantage by the possessers of telescopes of moderate size. Sir Howard Grubb contributes a paper dealing with the points to be attended to in purchasing, testing, adjusting, and taking care of a telescope. An article on the sun is written by Mr. E. W. Maunders, of the Greenwich Observatory. It is devoted solely to observations of phenomena shown by a telescope on the surface of our luminary; in an appendix he describes the method of calculating the area and the heliographic latitude and longitude of a spot. As, however, the areas and positions of spots are obtained at the Royal Observatory from photographs of the sun's surface taken at stations in various parts of the globe, it seems to us an unnecessary reduplication of work for private observers to undertake it, especially as their results are not likely to be as accurate. From the chapter on the moon it appears that, in spite of the careful scrutiny to which our satellite has been subjected, there are still many points on which further information is required. Mr. W. F. Denning, well-known for his work on the planets and meteors, is the writer of an article on the planets; and here, again, we are reminded there is a wide field of work for the careful observer. An account of the precautions to be taken in observing double stars is given by Mr. S. W. Burnham, while Mr. J. E. Gore has compiled a list of binary stars for which orbits have been computed; he also contributes an article on variable stars. The subject of star colours is dealt with by Mr. W. S. Franks, while Mr. T. W. Backhouse and Mr. J. Rand Capron respectively write on stellar distribution and auroras. We would strongly urge all amateur astronomers, even if they only possess a good pair of opera-glasses, to obtain this volume, as from it they will learn what work lies within the power of their instrument, and may even be encouraged to become observers.

Electrical Instrument Making for Amateurs. By S. R. Bottone. Whittaker and Co.

This little book is addressed to amateurs, who are expected to have a very modest supply of tools and a good deal of patience. The why and wherefore of the action of the electric machines, and dynamos, seem to be carefully avoided, and the preface states that "this work does not profess to teach the science of electricity." We think in these days of smattering this is a mistake; it would be far better to put a book describing one form of electric machine only, with a clear account of the principle on which it acts, into the hand of a schoolboy, who could set to work with a fair grasp of what he was going to do, than to present descriptions of five electric machines, and an electrophorus, and four dynamos, leaving him to take his chance of understanding them, even if he succeeds in constructing them and making them work. How many owners of electric machines or induction coils have the smallest knowledge of their action, and use them merely as toys; and if they are home-made, without such knowledge (and with a little patience and ingenuity they might be put together by the help of this book), it can hardly be said that a step has been taken in the right direction. The author would "strongly recommend every student to make an electrophorus, and not to rest satisfied until he has fully mastered the theory of its action." Half a page would have at least given him some hint towards the solution of a problem which we do not think that one "amateur" in a hundred would solve by the light of nature. Instructions are given for the making of galvanometers, induction coils, etc., and several useful hints on working glass plates and insulating are to be found. The directions for graduating an ammeter are, however, quite impracticable, and those for the voltmeter are little better.

The Shell-Collector's Hand-Book for the Field. By J. W. Williams, M.A., D.Sc. London: Roper and Drowley, 1888.

It is a pleasing duty to bring under the notice of our readers a hand-book the aim of which is to supply collectors of British land and fresh-water shells with what has been long wanted by them, viz., a collection of descriptions of recognised varieties, in addition to a conspectus of the classes, orders, families, and genera, and descriptions of species. Of the three introductory chapters, those on the anatomy of a snail and fresh-water mussel are good, and are written in a pleasingly clear style, and the energetic student, with time at his disposal, will find the lists of books of reference appended to these chapters of great use. In the chapter on collecting and preserving, sound advice is given, which many collectors would do well to follow. We are surprised, however, that the scoop is not recommended for taking aquatic species, which is generally considered to be much better for the purpose than a water-net, and we do not think the removal of the confervoid growth so often found upon shells is any improvement. Errors and omissions are not altogether wanting; in fact, a perusal of the 148 pages of the book discovers far too many; but we have no desire to find fault, and will only mention that we looked for several varieties of *Arion ater* of which we could find no mention, and these included the well-known var. *plumbea* of Mr. Roebuck. The general plan of the book is perhaps its chief failing. Bound in limp covers it is essentially a pocket-volume, "for the field," but it is seldom required to examine shells before home is reached, and surely there was no need to keep the book within pocket size, when notes on habits and distribution would have so greatly enhanced its value. We are glad to find that the nomenclature adopted is that which is understood by the rank and file of shell-collectors—name changes should never be introduced in a little hand-book like the present—and, with the exception that Moquin-Tandon's subgeneric title *Eulimax* is used, the young collector will find nothing with which

he is unfamiliar. Having regard, however, to the views recently expressed by the author in a paper contributed to *Science-Gossip*, we expected to find the name *Lehmannia marginata* substituted for *Limax (Eulimax) arborum*. Notwithstanding its slight deficiencies, the hand-book with which Dr. Williams has furnished us will be found of great use, and most conchologists, especially those who reside far away from the great public libraries, unless they wish to part company with their fellow-workers, will doubtless avail themselves of its help during the years which must elapse before the comprehensive and exhaustive monograph upon which Messrs. Taylor and Roebuck, of Leeds, have for some years past been engaged, can be expected.

Boys' Games. A Recreation Handbook for Teachers and Scholars. Edited by E. D. Bourne. Price 6d.

Girls' Games. A Recreation Handbook for Teachers and Scholars. Edited by E. D. Bourne. Price 6d. London: Griffith, Farran, Okeden and Welsh.

These two little books are both calculated to be very useful. The introduction to both contains some matter which may well call for serious reflection. The author admits some at least of the main points in the necessary indictment of the "tendencies of the age." He says, "The wear and tear of life as regards its mental, if not its bodily, condition, the strain of nerve and the expenditure of brain power have increased with the pressure of population and competition"—a pressure, surely, which in many respects has been needlessly and wantonly created! Again, "it is our duty to lessen, as far as can be, the fresh difficulties that modern progress (!) has put in the way of our young people's proper growth." It may well be asked whether anything which puts difficulties in the way of the vigorous development of the people deserves to be called "progress" save in an ironical sense.

So long as Governments, irrespective of party, are encouraging the present systems of education, what the individual—be he teacher or author—can effect will be little.

Still more urgent, because less regarded, is the necessity of improved physical training for girls, a matter which has been most fearfully neglected alike by mothers and by the heads of schools. The abuses of language have often been fraught with grave mischief, but perhaps the saddest instance of this kind on record is the common use of "delicacy" as a synonym for debility and the kindred employment of such expressions as "rude health."

The Journal of the Franklin Institute. Series iii. Vol. XCV. No. 1, January 1888, and No. 2, February, 1888.

By far the bulk of the matter contained in these numbers is of too strictly technical a character to interest the non-professional reader. We notice, however, a paper on the "Japanese Magic Mirror," by Mr. F. E. Ives. He observes that these mirrors are slighly convex, and when they are placed several feet from the eye objects reflected in them appear irregularly distorted. He concludes that to reproduce the figures at the back of the mirror, it is sufficient to have the surface slightly less convex on these parts. In proof it is mentioned that if the mirror is flattened by pressure, the figures vanish from the reflection. The first of these magical mirrors was probably not produced intentionally.

Another noteworthy paper by the same writer is on the "ether-oxygen lime-light," which is now coming into use instead of the oxy-hydrogen for exhibiting dissolving views, etc. Owing to recent improvements it is free from noise, flickering and danger. It is worked not with ordinary ethylic ether, but with petroleum ether, which is cheaper, evaporates at a lower temperature, and contains neither alcohol nor water.

RAPID METHODS OF PREPARING LANTERN-SLIDES.

LANTERN-SLIDES are often wanted in a great hurry, when photography is of course out of the question. The following methods may be substituted with advantage where nothing but line work is required:—

(1) Rub a warm glass plate with a paraffin candle, wipe it nearly clean, and smoke with a camphor flame till a uniform coating of dark brown is obtained. Upon this ground figures may be drawn with a needle.

(2) Smoke a clean plate, and, after etching, fix the film by the vapour of heated alcohol. The plate may then be secured with photographic varnish.

(3) Coat a plate with thin gelatine solution (warm). When dry, pen-and-ink drawings may be made on the surface so prepared. Clean, dry slides can be stored for future use.

(4) Stain a good photographic varnish with some aniline colour soluble in alcohol. Ruby, purple, and blue are good colours to use. Mix a little mastic with the varnish to get a suitable texture when dry. The exact proportion must be determined by trial for each kind of varnish. If too much mastic is used, the film becomes "matt," and chips easily when dry. Varnish a number of plates with this solution, just as the photographer varnishes negatives. The plates are dry in a very few minutes, and ready for use.

A retouching-desk is necessary for careful work. The needles for etching should be mounted in sticks, and care must be taken that they are not so long as to be flexible.

Process 4 is the best for ordinary use. Any number of slides can be varnished beforehand, and kept in a box for emergencies. The tinted ground has a very pleasant effect on the screen. Lastly, the slides can be put into the lantern without cover-glass, if time presses. Some lecturers, who have the lantern always at hand, use such slides for rapid, almost extemporaneous, diagrams, for tables of figures, and even for examination papers. A large class can copy down any written matter from such slides with great ease. When done with, the slides are readily cleaned. Very artistic and beautiful work can be turned out by a good draughtsman on the delightfully free surface of the varnished plate.

VIOLET COPYING INK.—Dissolve 40 parts of extract of logwood, 5 of oxalic-acid, and 30 parts of sulphate of aluminium, without heat, in 800 parts of distilled water and 10 parts of glycerine; let it stand twenty-four hours; then add a solution of 5 parts of bichromate of potassium in 100 parts of distilled water, and again set aside for twenty-four hours. Now raise the mixture once to boiling in a bright copper boiler, mix with it while hot 50 parts of wood vinegar, and, when cold, put into bottles. After a fortnight decant from the sediment. In thin layers, this ink is reddish-violet, it writes dark violet, and furnishes bluish violet copies.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on March 22nd, a paper on the "Skull, Brain, and Auditory Organ of a new species of Pterosaurian (*Scaphognathus Purdoni*), from the upper Lias, near Whitby, Yorkshire," was read by Mr. E. T. Newton, F.G.S., F.Z.S.

The specimen described in this paper is the skull of a Pterodactyle, which was obtained from the Upper Lias, near Whitby, and appears to be the first example of these interesting animals found in Yorkshire. It is most nearly related to the form from the Solenhofen Slates, which is known as *Pterodactylus* (*Scaphognathus*) *crassirostris*, and is to be named after its owner, the Rev. J. W. Purdon, *Scaphognathus Purdoni*.

This fossil skull is about five-and-a-half inches long, but has lost, perhaps, two inches of the front of the snout. The various bones of the skull are better shown than in any Pterosaurian hitherto discovered, notwithstanding that so many examples have been found on the Continent and in this country; and the back, base, and palatal regions have never before been definitely described. The base is remarkable for its great depth and flattening from before backwards, as well as for the pair of long basi-pterygoid processes, which pass down to the inner angle of the large quadrate. The palatine and pterygoid bones are united into one bar, and anteriorly this forms the hinder boundary of the internal nostril, which is completely surrounded by bone and placed far forwards. The back of the skull exhibits a pair of wing-like par-occipital processes closely resembling those found in some lizards, and, indeed, the structure of the entire skull is most like that of a lizard, although in some points having a very bird-like appearance.

By carefully cutting away the frontal and parietal regions of the left side, the author has been able to expose a cast of one-half of the brain, which proves to be very small in proportion to the skull, and in this particular, therefore, resembles the brain of a reptile; but in its structure it shows a greater affinity to the birds. The cerebral lobe is oval in shape, and directly behind it, on the side of the brain, there is a large optic lobe, which although extending to the upper surface does not meet its fellow of the opposite side, as is the case in all reptiles, but seems to have been separated from it by the forward extension of the cerebellum, in a manner similar to that which occurs in birds. The peculiar lobe of nervous matter found at the side of the medulla in birds, and known as the flocculus, is present in this Pterodactyle, but does not occur in reptiles. The American toothed-bird, *Hesperornis*, had a brain very closely resembling this Pterodactyle, although proportionately larger.

It is not a little interesting to find that this Yorkshire fossil gives us some information as to the auditory organ of the Pterosauria. In close relation to the flocculus, portions of three semicircular canals have been uncovered which agree so closely in position with the bony semicircular canals of the bird's auditory apparatus, that there can be no doubt as to their having been of a similar nature. The fenestra ovalis has been found similarly placed to that of the chameleon; and this fact, together with the form and position of the quadrate bone, leads the author to conclude that, like the chameleon, this Pterodactyle had no ear drum.

In considering the relation which the Pterosauria bear to reptiles and birds, it would seem that in the structure of the skull they are related to the Lacertilia, while the form of the brain allies them more closely to the birds. This, however, does not constitute the Pterosaurian a transitional form between birds and reptiles, in the sense of the Pterosauria having been derived from reptiles, or of the birds having been derived from Pterosauria; but rather points to *Aves*, *Pterosauria*, and *Reptilia* having been derived from some common ancestral type.

An interesting paper was read at the meeting on March 22nd, entitled "The Chemical Composition of Pearls," by George Harley, M.D., F.R.S., and Harald S. Harley. Dr. George Harley began by explaining that during his investigation into the nature and mode of formation of the different kinds of stones met with in the human body, he had been so struck with the close similarity in appearance of some of them with pearls, that he was led to examine the latter very minutely, and finding that although there are many qualitative analyses of pearls, there is no evidence in their voluminous literature of a quantitative analysis of their ingredients having been recorded, he undertook the examination, of which the following is an account, of several varieties:—

Of oyster pearls, three varieties were examined—British, Australian, and Ceylonese.

Qualitative analysis showed that they all had an identical composition, and that they consisted solely of water, organic matter, and calcium carbonate. There was a total absence of magnesia and of all the other mineral ingredients of sea-water—from which the inorganic parts of pearls must of course be obtained. Seeing that ordinary sea-water contains close upon ten and a half times more calcium sulphate than calcium carbonate, one might have expected that at least some sulphates would have been found along with the carbonates, more especially if pearls are the mere fortuitous concretions some persons imagine them to be. This view the authors could not endorse, from the fact that by steeping pearls in a weak aqueous solution of nitric acid, they were able to completely remove from them all their mineral constituents without in any way altering their shape, and but very slightly changing their naked-eye appearances, so long as they are permitted to remain in the solution. When taken out they rapidly dry and shrivel up. No phosphates whatever were found in any of the three before-named varieties of pearls.

Having ascertained that all three kinds of pearls had exactly the same chemical composition, instead of making separate quantitative analyses of them, as pure white pearls are very expensive, the authors simply selected two pearls from each variety, of as nearly the same size and weight—giving a total of 16 grains—and analysed them collectively, the result obtained being that they consisted of carbonate of lime, 91·72 per cent.; organic matter (animal), 5·94 per cent.; water, 2·25 per cent.

A pearl said to be the product of a cocoa-nut was examined by the authors. It had all the external appearances of the pearls found in the large clams (*Tridacna gigas*) of the Southern Ocean, being perfectly globular, with a smooth, glistening, dull white surface, and resembling them exactly in microscopic structure. Besides which in chemical composition it bore no similarity to cocoa-nut milk, to which it is supposed to be related.

For cocoa-nut milk is said to contain both the phosphate and the malate, but not the carbonate of lime. That there may be pearls found in cocoa-nuts, the authors do not presume to deny; but they are doubtful whether the specimen examined had such an origin.

As far as naked-eye appearances are concerned, a good specimen of the variety of so-called mammalian pearl is quite undistinguishable from a fine specimen of oriental oyster pearl, from its not only being globular in shape, and of a pure white colour, but from its also possessing the iridescent sheen so characteristic of oriental oyster pearls of fine quality.

In chemical composition, however, mammalian pearls bear no similarity whatever to pearls found in shell-fish, for they are composed of an organic instead of an inorganic material, namely cholesterin. In minute structure again, they bear a marked resemblance to the crystalline variety of shell-fish pearls.

As regards the hardness of pearls, again, it may perhaps be as well to remark that really good pearls are very much denser than the majority of persons appear to suppose. This may be judged of from the following facts.

Being on one occasion desirous to crush into powder a split-pea-sized pearl, Dr. George Harley folded it within two plies of ordinary note-paper, lifted up the corner of the carpet and having placed it on the bare wooden floor stood upon it with all his weight—which is over twelve stone—yet neither that amount of pressure nor the stamping upon it with the heel of his boot sufficed to make the slightest impression on the pearl. It was next given to the servant to break with a hammer; and when he returned he informed us that on his attempting to fracture it with the hammer against the pantry table, all he succeeded in doing was to make the pearl cut its way through the paper, and sink itself into the wood of the table, as if it had been the top of an ordinary iron nail, and that it was not until he had struck it a hard blow with the hammer against the bottom of a flat-iron that he was able to break it.

It may be further, perhaps, as well for us to mention that shell-fish pearls are not anything like so easily dissolved in vinegar as the pretty tale of Cleopatra having taken a large pearl from her ear, and after dissolving it in vinegar drunk it to the health of her lover Antony, would lead one to imagine. For during the course of our experiments we have ascertained that two or three days would not suffice to dissolve, in cold vinegar, a good hard pearl, larger than a garden pea, while hours would be required to extract all the mineral matter from it, were even the vinegar employed in a boiling state. But this is not all; for after every particle of earthy substance had been dissolved the pearl would still remain of the same bulk, and almost of the identical same appearance as before, in consequence of its organic matrix being totally insoluble in vinegar. Hence if the Cleopatra legend is to be believed at all, it requires to be considerably modified before it can be made to accord with scientific truth. The only way, indeed, in which the fair lady could have made her pearl disappear by solution at the supper-table, would have been by having it pulverised by a hard hammer and a strong arm before applying the vinegar to it. For when in a state of impalpable powder the mineral substance of the pearl would effervesce like a Seidlitz powder—though less strongly—and then when diluted with water be transformed into a refreshing cooling lover's drink; while the animal matter would at the same time be in such a state of fine division as not to be readily appreciable by the eye.

ROYAL METEOROLOGICAL SOCIETY.

At the monthly meeting held on the 21st March, the President (Dr. Marcet) delivered an address on Atmospheric Electricity. He first alluded to Franklin, who, in his experiments in America in 1752, succeeded in obtaining the electricity of a storm-cloud by conducting it along the string of a kite sent into the cloud. De Romas, in Europe, repeated the experiment, and, having placed a wire within the twine his kite was attached to, obtained sparks of nine or ten feet in length. The characters of the two kind of electricities were next described, the vitreous or positive, which was produced by rubbing glass, and the resinous or negative obtained by rubbing sealing-wax or other resinous substances; and it was shown, by bringing suspended balls of pith within the influence of these electricities, that electricities of different kinds attract each other, and those of the same kind repel each other. De Saussure's and Volta's electroscopes were next described, pith balls being used in the former and blades of straw in the latter for testing the pressure of electricity. With the object of measuring the force of electricity, Sir W. Thomson's electrometer was mentioned, in which the electricity is collected from the air by means of an insulated cistern letting out water drop by drop, each drop becoming covered with electricity from the atmosphere, which runs into the cistern, where it is stored up, and made to act upon that portion of the instrument which records its degree or amount. The atmosphere is always more or less electrical, or, in other words, possessed of electrical tension, and this is nearly always positive; while the earth exhibits electrical characters of a negative kind. The effects of atmospheric electricity were classed by Dr. Marcet under three heads.—1st. Lightning in thunderstorms. 2nd. The formation of hail. 3rd. The formation of the Aurora borealis and Australis. He explained how clouds acquired their electrical activity by remarking that clouds forming in a blue sky, by a local condensation of moisture, became charged with positive electricity from the atmosphere; while heavy dark clouds rising from below nearer to the earth were filled with terrestrial negative electricity, and the two systems of clouds attracting each other would discharge their electricity, giving rise to flashes of lightning. In some cases a storm-cloud charged with positive electricity would approach the earth, attracting the terrestrial negative electricity, and when within a certain distance shoot out a lightning which would apparently strike the earth; but it would just as well have struck the cloud, only there was nothing in the cloud to sustain any damage, while on the earth there were many objects lightning would destroy, to say nothing of its effects upon animal life. Thunder is the noise produced by the air rushing in to fill up the vacuum made by the heat of the lightning flash. There may be sheet lightnings, zig-zag or forked lightnings, and globular lightnings. The latter are particularly interesting from their assuming a spherical form. Illustrations were given of objects struck by lightning, the most remarkable being, perhaps, the clothes of a working man, which were torn into shreds while the man himself was not seriously injured. Dr. Marcet next proceeded to show a flash of lightning, which he pro-

duced by throwing on a white screen the image of an electric spark two or three inches in length, enlarged by means of the lens of an optical lantern: forked lightning, six or eight feet in length with its irregular zig-zag course was most clearly demonstrated. After alluding to the protecting power of lightning conductors, and their construction, Dr. Marcet explained the formation of hail and of waterspouts, and exhibited an instrument by Prof. Colladon, of Geneva, for showing the formation of waterspouts. He concluded his address with a few remarks on the Aurora borealis and Australis the formation of which was illustrated by de la Rive's experiment, which consisted of successive discharges of electric sparks through a partial vacuum while under the influence of a powerful magnet; electric sheets of light were seen assuming the form of bands, and possessed of a certain rotating motion.

Mr. G. J. Symons, F.R.S., read a short communication on "The Non-existence of Thunderbolts," and briefly described the history of several so-called thunderbolts, the specimens obtained being of an amusing character, thus clearly showing that they were of a terrestrial and not a celestial nature.

READING LITERARY AND SCIENTIFIC SOCIETY.

At a meeting held on March 13, the Rev. H. C. Lang, M.D., F.L.S., gave a lecture on "Mimicry, as illustrated by moths and butterflies." The chair was filled by Mr. O. A. Shrubsole, F.G.S., who gave some illustrations of mimicry from among the higher forms of animal life.

According to the author the word "mimicry" is taken to express a phenomenon in nature, or, rather, a law by which certain animals imitate more or less closely other natural objects or other species of animals for the purpose of self-preservation. The principle of mimicry is but a development of the great law of protective colouration. There is in all organic beings under the influence of solar light, a tendency to the production of colour. But it is an almost universal rule that each species of animal has enemies in the shape of other species, which seek to feed upon it; or that it seeks itself to feed on other animals. In the first case it has to escape its enemies or it cannot long continue to live. In the second case the animal who is in pursuit must also be concealed from his prey or he will be seen; his prey will seek concealment, and he will be starved. But colour is in itself conspicuous and does not tend to further concealment, hence the necessity for "protective colouring." In some cases protective colouring is unnecessary, as when an animal is protected in other ways and does not need to be concealed. Sometimes even bright colours are a protection, as when an animal is poisonous or otherwise unfit for food. Protective colouring is common among the vertebratæ, but more so among the invertebrate animals, particularly among the class of insects, and in this class especially in the order lepidoptera, where bright colouring is frequent, and where the species are preyed upon by a variety of enemies, such as birds, reptiles, predacious insects of other orders, but most of all by birds. There are two kinds of protective mimicry: (1) Where the form or colour of other natural objects is imitated, such as leaves, stones, moss, lichen, wood, etc. Instances were given and specimens of lepidoptera were exhibited to illustrate this. (2) Where certain species of lepidoptera which would otherwise be preyed upon by birds, escape destruction from their remarkable resemblance to other species of an uneatable or poisonous kind. In tropical countries the butterflies of the families *Danaidæ* and *Heliconidæ* are highly distasteful to birds on account of the fact that they exude an acrid and strongly-scented fluid, and they are found in numberless instances to be imitated by butterflies of totally distinct families, which do not possess the protective advantages of the others. Illustrations of a few striking examples were demonstrated, among which may be instanced the case of *Papilio Merope*, an African butterfly, the females of which, instead of resembling the males, take different forms in imitation of various species of *Dandis*. In South America the *Heliconidæ* are found to be extensively imitated by butterflies of the family *Pieridæ*.

SOCIETY OF ANTIQUARIES OF SCOTLAND.

The second meeting of this society for the current session was held in Edinburgh on the 10th March, Mr. Robert Herdman, R.S.A., vice-president, in the chair. The first paper was entitled "The Archæology of Lighting Appliances," by Mr. J. Romilly Allen, F.S.A.Scot. After describing the essential parts of an oil-lamp, the author proceeded to notice the different varieties of lamps which had been in use (from the Roman time downwards) in Britain, illustrating the subject by reference to the analogous forms of lamps and varieties of contrivances for promoting and regulating the combustion of the oil, in open or closed lamps, in use in different parts of the world. Referring to the open lamps of stone found in the Brochs, he compared them with the modern stone lamps of the Esquimaux and the Chukches, and in this connection the medieval cresset stones used for lighting the churches and cloisters were also described. The classical closed lamp of terra-cotta and the Roman hanging lamp of iron were next noticed, the latter being the prototype of the Scottish crusie, so familiar to our forefathers, but now becoming so rare that specimens are only to be seen in museums. After describing the various contrivances for supplying the oil to the wick, for regulating the supply, for trimming and hanging the lamp, and the various adaptations of the form of the lamp according to its special purpose, as for household use, or for lighting a workshop, a street, or a mine, he described the other varieties of lighting appliances for tallow or wax instead of oil. The old rush-holders, candlesticks, snuffers, etc., were arranged in their order of development, from the rudest and simplest to the most refined, and the paper was illustrated by a series of more than forty drawings, and a large selection of actual examples taken from the museum. In the second paper Mr. Gilbert Gowdie, treasurer of the society, dealt with the same subject from a more special point of view, describing a number of varieties of the Scottish crusie, with reference to examples in the museum, and illustrating the methods of their manufacture and use, with particular reference to Shetland, where it is somewhat remarkable that the common oil-lamp of the same form as that used throughout the rest of Scotland is not known by the name "crusie," but by the old Norse name "collie," the *kola* of the Sturlunga Saga and the Gisli Saga. Mr. Findlay and Sir Arthur Mitchell exhibited a number of examples of crusies from the Continent, and made some remarks on the similarities of different specimens from different countries.

THE HUNSLET MECHANICS' INSTITUTE.

In a lecture on "Water," Professor Smithells, of the Yorkshire College, dwelt upon the difference between pure and impure water. A sample of what people called pure water was, he said, far from being pure. The difference between pure and impure water was evident to the eye alone when seen in large quantities. If they converted a quantity of Leeds water into steam they would find that a certain amount of solid substance adhered to the sides of the vessel in which it was boiled. On boiling ordinary water by far the largest proportion of its substance disappeared in steam; but there was left a residue of solid matter, which existed in different waters in a greater or lesser degree, but in rain water least of all. Pure water could be entirely converted into steam, and left no solid matter. Distilled water was most unpalatable, owing to the absence of solids and gases. In passing through the air, in its descent, rain gathered and dissolved some of the air, which was found to exist in the proportion of eighteen gallons of air to a thousand of water. It water did not contain those eighteen gallons of air, marine life would not be possible. On reaching the earth, and coursing over it in streams, the water came into contact with the solid constituents of the earth's crust. For the most part the substances of which the latter was composed were not soluble in water, but there were certain substances which were dissolved. The most important solid substances in natural water were known as common salt, chalk, gypsum, magnesium, and ammonia and its compounds. It was self-evident how salt and gypsum, and such substances, got into water; but chalk was not soluble in water unless the latter contained a certain amount of carbonic acid gas. This gas was to be found in all natural water, but in some a great deal more than others. Lime was a desirable constituent of water. Water containing lime was not only a drink but a food, on account of its bone-forming capacity.

NEWCASTLE FOREMEN ENGINEERS' AND DRAUGHTMEN'S ASSOCIATION.

At the meeting of the 17th March, Mr. A. Taylor read a paper on "Latent Heat of Steam and Steam-engine Efficiency." The author divided his subject into two heads—first, latent heat of steam; and second, steam-engine efficiency. He described the foundation on which the first part of the subject rested as follows:—1st, Water has least bulk, that is greatest density, at a temperature of 39 degrees, and its bulk or volume increases as its temperature is raised above 39 degrees. Sea-water in rising from 39 degrees to 212 degrees expands 5 per cent. of its original volume; 2nd, it is acknowledged that if the particles of a pound of water at its greatest density (namely, 39 degrees) are agitated in such a manner as to absorb 772 ft. lbs. of mechanical energy, the temperature of the pound of water will be increased one degree; 3rd, the amount of heat necessary to raise water of greatest density one degree in temperature is called its specific heat at that temperature; this amount of heat is also called a unit of heat, and is in mechanical energy equivalent to the before-mentioned 772 ft. lbs. Steam-engine efficiency was the second branch of his subject, which he subdivided:—1st, By the capability of the boiler, including the furnace to convert and transfer to the water in the boiler a percentage of the total heat which can be theoretically generated by the perfect combustion of a given amount of coal, or, in other words, the evaporative efficiency of the boiler; and the capability of the cylinder or cylinders of the engine to convert a percentage of the heat of the steam into work done on the piston; in other words, to convert the energy in the steam into horse-power. In conclusion, he said that coal containing mechanical energy equal to 100 horse-power, gives 71 horse-power to the boiler, and the boiler gives this 71 horse-power to the engines, and the steam gives 12 horse-power to the piston, but this is not allowing for condensation which must take place in the cylinders on account of cold surface, etc. If this condensation and other losses be allowed for, the 12 horse-power may safely be reduced to 10 horse-power. When from this is taken the loss in friction of the moving parts of an ordinary marine engine, and the loss of propeller efficiency, the actual efficiency of the whole machine cannot exceed 5 per cent., in other words from coal containing mechanical energy equal to 100 horse-power we only get about 5 per cent. horse-power to drive a modern steamer.

JUNIOR ENGINEERING SOCIETY.

At the last meeting of this Society three brief papers on "A New Pneumatic Hand-tool," "Hooke's Joint," and "A Question in Steam Engine Efficiency," by Mr. F. H. Lewis, Mr. A. H. Tyler, and Mr. S. H. Wells respectively, were read and discussed. Mr. Lewis described the tool, a specimen of which was exhibited, as consisting of a cylinder, one end of which was closed by a spindle tool-stock held in position by a strong spring, and in which an air-pressure of 25 lbs. to 40 lbs. per square inch caused a piston to very rapidly reciprocate and to deliver a corresponding succession of blows to the head of the tool stock, in which tools of various forms, according to the character of the work, could be fixed. The applications of the tool were numerous—wood, stone, and iron being worked with equal facility. Mr. Tyler exhibited three models in illustration of the principle and development of Hooke's joint, and entered into a detailed explanation of the salient features of their construction. The question raised by Mr. Wells was as to whether, in considering the efficiency of a steam engine, the power required for driving the auxiliary engines should be regarded wholly as a loss. The conclusions drawn by the author were that in reference to the air, circulating, and bilge pumps, the power necessary to work them was lost, but as regards the feed pump nearly all the energy expended in driving it was recovered, and that it was therefore incorrect when ascertaining the total h.p. developed from the coal burned to add the h.p. indicated in the cylinder of the feed pump to that of the main and auxiliary engines, which appeared to be the course usually adopted, judging from reports of trial trips which had come under the author's notice.

EDINBURGH GEOLOGICAL SOCIETY.

Mr. Hugh Miller, at the meeting on the 16th March, communicated a paper by Professor E. W. Claypole on "The Eccentricity Theory of Glacial Cold versus the Facts." Professor Claypole explained at the outset the theory of Dr. James Croll, of Edinburgh, which accounted for the glacial era by the increased eccentricity of the earth's orbit producing a glacial climate on the hemi-

sphere whose winter occurred in aphelion. Professor Claypole went on to point out new facts which had come to light which tended to disprove this theory, which for fifteen years had been very favourably received. According to Croll's theory the glacial period, calculating from astronomical data, extended from 240,000 to 80,000 years before 1800 A.D. Professor Claypole argued that the rate of recession of the Falls of Niagara, owing to the erosion of the water, would give 15,000 years as the age of the gorge below the Falls, which was between six and seven miles long, and had probably been receding at a tolerably uniform rate since the end of the Ice Age. Again, the Falls of St. Anthony, on the Mississippi, were at the head of a gorge seven miles long, and their rate of recession gave an age of 8,859 years to the gorge, which was entirely post-glacial in age. Professor Claypole accordingly saw no possibility of maintaining an antiquity of 80,000 years for the final retreat of the Ice from the St. Lawrence and the Upper Mississippi valley, and he concluded that the Ice Age ended 10,000 or 15,000 years ago. If that were so, the cold could not have been due to increased eccentricity, as Dr. Croll contended. Mr. Hugh Miller gave some observations on a dust storm which he had witnessed in Eastern Ross. After a prolonged drought last summer, he had seen in June the dust from the turnip fields and fallow land flung up in dense clouds, as a kind of intermittent stream, which spread a pale brown haze over the whole district, not less than three or four hundred feet in depth in some places. The occurrence led to the remark that, except for the binding influence of vegetation, wind must rank as one of the most powerful geological agents. He gave instances of the wasting of cliffs to sand, the destruction of soils, and the slow disintegration of crags through this means. Dr. W. G. Black exhibited a new clinometer, which consists of a hollow hemisphere divided internally into degrees, and enclosed in a small box. When the box is set down on a stratum, a pellet inside the hemisphere indicates by its position the inclination of the stratum.

EDINBURGH FIELD NATURALISTS' SOCIETY.

At the meeting, on February 22nd, Mr. William Penman communicated a paper on the "Polar Dark-ground Illumination," and Mr. John Lindsay read a note on an "Ancient Lake Deposit in Queen's Park," which had been uncovered by recent operations in forming a new main drain there. From 3 ft. to 10 ft. of a superficial deposit and natural soil was first cut through, then a yellow clay, from 1 ft. to 4½ ft. thick; next a layer of peat, varying in thickness from 1 ft. to 14½ ft., and immediately underneath was the shell marl, from 5 ft. to 9 ft. thick. The marl was studded with countless myriads of fresh-water shells belonging to the genera *Limnæ*, *Valvata*, *Planorbis*, and *Cyclas*. Of some of these genera there were several species. The shells were very light, and extremely brittle. The lake must at one time have been very extensive, probably coming close up to, if it did not cover, the site of Holyrood Palace.

MANCHESTER SCIENTIFIC STUDENTS' ASSOCIATION.

At the meeting held on the 18th ult., Mr. R. Cobden Phillips delivered a lecture on the "Lower Congo," illustrated by views.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE ELECTRIC ACTION OF LEAVES.

In the SCIENTIFIC NEWS a correspondent seeks to explain the saw-like structure of the edges of the leaves of grass and of certain other plants by a "final cause." He refers to the well-known fact that electricity finds either ingress or egress by points more readily than by blunt, rounded masses. From this fact he draws the inference that leaves are able to draw off silently any accumulation of electricity, either in the soil beneath or in the clouds above, and thus prevent, or at least mitigate, violent lightning-strokes, whether ascending or descending. To decide upon the reality of this alleged action it would be necessary to make extended observations upon the incidence of thunder-storms. Are they more severe over seas, lakes, desert plains, etc., where there is, of course, an absence of vegetation, than over woods, prairies, or cultivated lands?

The question may also be raised whether it is legitimate to explain any peculiarity in the structure of a plant or an animal by reference to the supposed influence such peculiarity may have upon some other being. Z. Z.

GENERALISED PORTRAITS.

Your readers are, of course, aware of certain interesting results obtained by means of "generalised photographs." Thus, at the great Canadian meeting of the British Association, such portraits respectively of the naturalists and the physicists present, showed decidedly different types of head. Now it strikes me that a generalised portrait of the quack would be of no small value. This gentleman has become of late very fond of adorning his advertisements with a representation of his "refined and intellectual countenance," and it strikes me that I can in such portraits detect some common features. PHOS.

HEIGHTS OF WATERFALLS.

A paragraph given on p. 200 of the SCIENTIFIC NEWS makes no mention of the Falls of the Parana. That at Iguazu is calculated at 174 to 180 feet, being 30 feet higher than the Niagara. Its breadth is 1,000 yards, and its volume of water is enormous. The Guaira Fall on the same river is much larger still. S. T.

ETCHING ON BOXWOOD BLOCKS.—From the *Photographisches Archiv* we learn that in Russia a new method of producing etchings on boxwood blocks for wood engraving has been invented. The pores of the block are first filled with insoluble carbonate of copper, by means of two separate solutions, in which it is boiled sufficiently. The surface of the block is then polished, and asphaltum in solution applied to its back and sides. Finally, the polished face is coated with a film of bichromate gelatine. The block is then exposed under a negative, and the unaffected and soluble parts of the bichromate gelatine are removed by washing. The raised parts are next coated with an asphaltum solution, the block is immersed in a strong solution of nitric acid for about an hour, and is removed and subjected to the action of sulphuric acid for the same period. The parts unprotected are thus changed to nitro-cellulose, which, by brushing, is readily removed in the form of a greenish powder. Finally, the block is dried, and briskly rubbed with a stiff brush. Then the asphaltum is dissolved and removed by benzine, and the block is ready for printing. The invention is an ingenious one, and we shall be glad to hear that its practical application is successful.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

RAILWAY LAMP.—Messrs. J. Thorne and E. B. Burr, Gracechurch Street, London, have patented a lamp for railway and other purposes. One feature of the invention is the combination, with a lamp casing of an electric incandescent lamp, a battery, a lens, and a reflector, all arranged in the casing, so that the apparatus can be readily inserted or removed from its place without having to connect or disconnect any wire. Moreover, the casing does not require a ventilator, and can be closed to exclude dust. A parabolic reflector and a lens having a corresponding form are used, and are arranged relatively to each other, so that their foci will correspond with each other, and the rays of light concentrated by the reflector will pass through the lens, and extend therefrom in the form of a parallel beam. By the arrangement the light and reflector can be placed much nearer the lens, and thus leave space within the casing for the electric battery, and a greater intensity of light is also produced.

BED AND BEDSTEAD.—Messrs. J. Chorlton and G. L. Scott, of Manchester, have patented a bed and bedstead. To provide for the regular arrangement and spacing of beds in barracks, and to make them more capable of being easily, expeditiously, and neatly stowed away when not in use, the heads of such beds are made, so as to be capable of attachment to hinges upon a circular bar, preferably extending the whole length of the dormitory, and at a suitable distance from the wall. The bedsteads are preferably made with angle iron ends and tubular sides, and provided with elastic metallic mattresses. The sides are fitted with legs which rest upon the floor when the bed is in a position to be used. When not in use, the bed, either with or without the bedclothes, is turned up against the wall, by which it is supported in an inclined position, leaving a clear space on the floor. If it be desired to remove the beds to another situation the bolts for attaching the heads of the beds to the hinges are unscrewed, and the beds removed, leaving the hinge attachments for use in conjunction with other beds.

APPARATUS FOR CLEANING TENNIS BALLS.—Mr. J. Osmond, of Clifton, has patented an apparatus for cleaning tennis balls. Within a cylindrical casing a revolving brush is mounted of such diameter that, as it revolves, there is around it an annular space not quite equal in width to the diameter of the balls to be acted on, so thta no ball can pass through this space without causing the bending and consequent rubbing of the bristles on it. In this space is fixed inclined guides along which the balls, acted on by the revolving brush, are caused to travel as they roll, thus presenting a continually changing surface to the action of the brush. These guides lead the balls from the feeding mouth, to and fro along the length of the cylinder, exposed to the brushing action, until finally they are delivered at another mouth.

GAS SCRUBBERS.—A method of washing gases has been patented by Mr. H. C. F. Stormer, Christiania, Norway. This invention relates to apparatus which consists of a horizontal rotating tubular chamber, fitted with gutters rotated by any suitable means. The gutters are provided with fine perforations or notched along the edge. The chamber is filled to the required level with water and rotated; the gas to be treated enters at one end and leaves by the other, after having passed through the showers of falling liquor. When liquors are to be evaporated or concentrated, the chamber is charged therewith and rotated whilst the gases are passed through it. If a sediment be deposited it may be removed by rakes working through apertures at the ends.

HEATING APPARATUS.—A radiator for heating by hot water or steam has been patented by Mr. J. Jeffreys, Great Queen-street, Westminster. The radiator is formed with a top and bottom box of any convenient length and width, connected together by double tubes, lozenge-shaped in section, cast hollow to allow the water to circulate freely between the top and bottom boxes, and connected at each end to the latter by a wrought-iron bolt, screwed into the top and bottom of each tube and passing completely through the boxes, and secured by a nut on the outside. A hollow pillar is cast on the inside of the boxes in the centre of each tube, surrounded by a square rebated aperture to receive the end of the tube, and the joint is made between the two with a flat piece of india-rubber fitting tightly into the rebate and completely covering the aperture and the top of the pillar, which has a hole in the centre for the bolt to pass through, and two holes on either side to admit the water to the tubes. The bolt is passed through the central hole in the india-rubber flange and the hole in the pillar beneath, and tightly screwed up from the outside of the box, and the joint made watertight.

BOOK COVER.—A cover for books has been patented by Mr. J. Hess, 78, Winston-road, London, N. The invention consists of a metal frame fastened to the inside back of the cover in such a manner as to allow the book to be placed therein and taken out at will, without injury to the book. The metal frame is made with one or more clips on the back to secure it to the cover. It has three sides, and opens at both ends; two of the sides form jaws to press firmly against the sides of the book, to hold it securely in the cover, and the remaining side forms the back with the aforesaid clips on.

ELECTRICAL GAS-LIGHTER.—An apparatus for lighting gas by electricity has been patented by Messrs. A. Schweizer and S. Grünwald, Vienna. The lighting device is connected to the ordinary house telegraph circuit, either by means of a third wire running from the element or by inserting a resistance in advance of the signal. The benzine light is placed in a receptacle which is pivotted to the wall or other place. By pressing a stud, a lever rotates the receptacle, until a projection from the receptacle touches the knob, when the circuit is completed and the light ignited by the platinum coil.

HOUSE POISON.—If the condensed breath collected on the cool window-panes of a room where a number of persons have been assembled be burned, a smell as of singed hair will show the presence of organic matter; and if the condensed breath be allowed to remain on the windows for a few days, it will be found, on examination by a microscope, that it is alive with animalcules. The inhalation of air containing such putrescent matter causes untold complaints which might be avoided by circulation of fresh air.—*Philadelphia Bulletin.*

TECHNICAL EDUCATION NOTES.

Local Agricultural Education.—The Lancashire County Agricultural Society has decided to carry out the proposals of the Royal Agricultural Society, that experiments should be made in various districts for the purpose of educating farmers as to the best methods of forming permanent pastures, as well as increasing their knowledge of practical and theoretical agriculture. The society will offer prizes to young men between the ages of fourteen and twenty-four for competitive examination in practical agriculture and the chemistry of agriculture; lectures will be given throughout North Lancashire during the summer; and experiments will be made in the growth of potatoes and grass seeds.

Technical Institution for North London.—A deputation representing Islington, Hackney, and Stoke Newington had an interview at Gwydyr-house, Whitehall, on March 26, with Mr. Anstie, Q.C., Charity Commissioner (who was accompanied by Mr. Bond, Assistant Commissioner, and Mr. Batten), with reference to a proposed scheme of technical institutes for the north of London. The deputation consisted of Dr. Payton, Director of the Polytechnic Institution, the Vicar of Islington, the Rector of Hackney, Mr. Dewey, and Messrs. Lang, Cable, Holmes, and Jobson. Mr. Jobson stated the views of the deputation, from which it appeared that the Commissioners had suggested to a previous deputation that St. Pancras, Islington, Hackney, and Stoke Newington should combine in order to formulate an educational scheme which would benefit the north of London. Since that time three of the parishes—Hackney, Islington, and Stoke Newington—had met, but St, Pancras had declined to join them, and they now desired to know what assistance they could get out of the City Parochial Funds for their scheme. It would be difficult to raise money, but, supposing that they raised £60,000 in Islington and Hackney, could the Charity Commissioners promise them one-half of that amount? Mr. Anstey said that the Charity Commissioners' proposal to South London was to contribute pound to pound to be applied rather to permanent endowments than to pay any preliminary expenses. The Commissioners were very anxious in any scheme that was proposed that provision should be made for children between the ages of thirteen and sixteen to continue their instruction, and they particularly wished to benefit the poorer classes. In fact, they were bound to do so under the provisions of the Act. If St. Pancras stood outside, then the Commissioners would have to treat with the three parishes alone. He urged them very strongly to use every effort to get as much money as possible. The Commissioners would look most favourably upon a scheme which contained in it the promise of the largest contributions.

ANNOUNCEMENTS.

The Royal College of Physicians of London.—Sir Andrew Clark, M.D., LL.D., F.R.S., has been elected president of this college.

Institution of Civil Engineers.—Before commencing the ordinary business at the meeting on March 27th, Mr. George B. Bruce (the President) alluded to the death of Mr. T. E. Harrison, a past president, whose name had, he said, appeared as a member on the books of the institution for fifty-four years, and to whose personal and professional qualities he paid a high tribute.

Royal Literary Fund.—The attendance at the dinner of the Royal Literary Fund, at which Sir James Paget will preside, on Wednesday, May 2, promises to be exceptionally full. Many of the leading members of the medical profession, both in London and the provinces, and several Fellows of the Royal Society have already signified their intention of supporting the chairman, and there is every prospect of the the gathering being one of the most brilliant that has taken place for many years.

Royal Institution.—The following are the lecture arrangements for after Easter: Dr. Charles Waldstein, three lectures on "John Ruskin"; Mr. Walter Gardiner, three lectures on "The Plant in the War of Nature"; Mr. Sidney Colvin, three lectures on "Conventions and Conventionality in Art"; Professor Dewar, six lectures on "The Chemical Arts"; Professor T. G. Bonney, three lectures on "The Growth and Sculpture of the Alps"; Mr. Carl Armbruster, seven lectures on "The Later Works of Richard Wagner" (with vocal and instrumental illustrations); Professor C. E. Turner, three lectures on "Count Tolstoi as Novelist and Thinker." The following are the probable arrangements for the Friday evening meetings for the ensuing session: Professor Flower, "The Pygmy Races of Men"; The Right Hon. Sir William R. Grove, "Antagonism"; Mr. James Wimshurst, "Electrical Influence Machines"; Professor J. K. Laughton, "The Invincible Armada; a Tercentenary Retrospect"; Mr. W. H. Barlow, "Building the New Tay Bridge"; Mr. Francis Galton, "Personal Identification and Description"; Professor J. A. Ewing, "Earthquakes, and how to measure them"; and a discourse by Professor Dewar.

Bethnal-green Free Library.—The twelfth annual meeting of the supporters and friends of this library was held recently at the Institution, London-street, Bethnal-green. Lord Brassey occupied the chair, and amongst those present were Professor Seeley, the Rev. Septimus Hansard, Mr. F. A. Bevan (the treasurer), Mr. Haysman, and the Rev. Dr. Tyler. The report of the committee stated that the past year had been one of steady progress in all departments of the library; the inhabitants of Bethnal-green and the surrounding districts continued to avail themselves largely of the advantages offered, and that at times it had been found difficult to afford them sufficient accommodation. The number of books presented during the year was 973, raising the stock to 35,106. The free lectures included a course of illustrated scientific lectures by Professor Seeley and a course of lectures on health by Dr. Barnard O'Connor. Other evenings had been given to high-class concerts, and a series of Saturday night popular concerts had been given. The evening classes showed steady progress, a larger number of students taking prizes. The number of persons attending the library, lectures, and classes was estimated at 42,000. The income during the year was £832, and the expenditure at £828. The report concluded with an appeal for funds for the contemplated building, towards which it was stated that Sir H. Tyler had promised £1,000. Lord Brassey, in the course of a short address, announced his intention of becoming an annual subscriber, and said they must have schools of art and libraries like this planted in every part of the metropolis, and that he believed that the good work being done in this institution only needed to be known to bring in a large addition to their funds.

Barcelona Exhibition, 1888.—The Secretary of State for Foreign Affairs has communicated to the Society of Arts a despatch from Her Majesty's Ambassador at Madrid, reporting on the present state of the intended Exhibition at Barcelona, in which Sir Francis Clare-Ford refers to the condition of the Exhibition, and the rapid progress which is being made in the improvement of the City of Barcelona by the erection around the Exhibition of many fine buildings. Gardens are being laid out where before were unseemly pieces of waste ground. An aquarium is to be built on the sands, and commodious bathing-houses and tents are to be erected; one of these is to be arranged for the especial use of the Queen-Regent. It is stated that there will be over 30,000 exhibitors, of whom only 80 are English; 3,500 square yards are assigned to the Barcelona Province alone, of which 3,000 have already been secured. The first batch of goods for the Exhibition has arrived from Germany and Austria; and great efforts are being made to insure the success of the French portion of the Exhibition. In the agricultural pavilion a space of 800 square yards has been assigned for French agricultural products. The ambassador expresses the opinion that the date for the opening of the Exhibition will have to be postponed, as it cannot be ready much before the first week in May.

DIARY FOR NEXT WEEK.

Monday, April 9.—Society of Arts, Cantor Lecture, at 8 p.m. —*Milk Supply, and Butter and Cheese Making;* By Mr. Richard Bannister.
Society of Chemical Industry, at 8 p.m.—*The Present Position and Prospects of the Coal Gas Industry;* By Mr. Lewis T. Wright.
Victoria Institute, at 8 p.m.—*Investigations on the Science of Language and Ethnography;* By Professor Leitner. *The Glacial Period on the East Coast of Canada;* By Professor Honeyman, D.C.L.
Aristotelian Society, at 8 p.m.—*Heraclitus and his Philosophy;* Dr. Clair J. Grece.

Tuesday, April 10.—Royal Institution, at 3 p.m.—*John Ruskin;* By Dr. C. Waldstein.
Royal Colonial Institute, at 8 p.m.—*South Africa;* By Sir D. Currie.
Institution of Civil Engineers, at 8 p.m.—*Compressed Oil Gas, and its Appliances;* By Mr. A. Ayres.

Wednesday, April 11.—Society of Arts, at 8 p.m.—*Recent Legislature concerning the Pollution of Air and Water;* By Alfred E. Fletcher.
Sheffield Pharmaceutical and Chemical Society.—*Fermentation;* By F. Spurr.
Cardiff Amateur Photographic Society.—*Platinotype Printing Practically Demonstrated;* By Mr. S. W. Allen.
Civil and Mechanical Engineers' Society, at 7 p.m.—*Theatres and other Public Buildings;* By Mr. Walter Emden.
Royal Microscopical Society, at 8 p.m.—*Fusoldt's Test Plates;* By Dr. R. H. Ward.

Thursday, April 12.—Royal Society, at 4.30 p.m.
Society of Telegraph Engineers and Electricians, at 8 p.m.
Royal Institution, at 3 p.m.—*The Chemical Arts;* By Professor Dewar, F.R.S.

Friday, April 13.—Society of Arts. Indian Section, at 8 p.m.—*The Experience of Twenty Years in Conducting Agricultural Inquiries in Southern India;* By Mr. W. R. Robertson, M.R.A.C.
Royal Institution, at 9 p.m.—*The Pygmy Races of Men;* Professor Flower.
Institution of Civil Engineers. Students' Meeting, at 7.30 p.m.—*Joy's Valve-Gear Applied to Locomotives;* By H. Hawkshaw Carrick.

Saturday, April 14.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner;* By Mr. C. Ambruster.
Physical Society, at 3 p.m.—*On the Measurement of the Electro-Motive Force of Dynamos;* By Professors W. E. Ayrton and J. Perry. *On the Variation of the Co-Efficients of Induction;* By Mr. W. E. Sumpner. *Some Experiments on Soap Bubbles;* By Mr. C. V. Boys. *On Electro-Motive Forces by Contact;* By C. V. Burton.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Meerschaum and Briar Pipes repaired, mounted, or cased; ambers fitted.—W. GEORGE, 324, Essex-road, Islington, London.

Trouser Lengths, 5s., Cheap Cloth for Ladies' Dresses, Mantles, Suits. Patterns free.—HEWITT, 27, Winfield, Leeds.

Dynamo, 120-candle power, improved armature, 100s. Photo. 5 stamps.—D. WALTON, Hebden Bridge, Yorkshire.

Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps Castings, lamps, etc.; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s.; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch, London—All Letters, Britannia Tool Factory, Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new appliances, metal spinning, milling, etc., in an ordinary lathe; 3s. post free.—Britannia Company, Colchester.

Minerals.—12 named specimens, 2s. free; 12 lias fossils, 2s. 6d. —CHAS. WARDINGLEY, 30, Blackwood Crescent, Edinburgh.

Patents.—Nine months' protection, 50s.; patent completed from £6 10s.—P. M. ROGERS, 21, Finsbury Pavement.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or **Machinery** taken in exchange for new goods or work done to order.—BUTLER BROS. 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

Encyclopædia Britannica. Vol. XXIII. (T-Ups.) Edited by W. Robertson Smith, LL.D. Containing 625 articles. Edinburgh: Adam and Charles Black. Price 30s.

Encyclopædia Britannica. Part 89 (T-Thackeray). Part 90 (Thalberg-Tokio). Part 91 (Toland-Turkestan). Part 92 (Turkey-Upsala). Edited by W. Robertson Smith, LL.D. Edinburgh: Adam and Charles Black. Price 7s. 6d. each part.

Electric Light Arithmetic. By R. E. Day, M.A., Evening Lecturer in Experimental Physics at King's College. London: Macmillan and Co. Price 2s.

The Long White Mountain; or, a Journey in Manchuria With an account of the History, Administration and Religion of that Province, with ten full-page illustrations, a map, and 28 illustrations in the text. By H. E. M. James, of Her Majesty's Bombay Civil Service. London: Longmans, Green and Co. Price 24s.

The Fundamental Principles of Chemistry practically Taught by a New Method. By Robert Galloway, M.R.I.A., F.C.S. London: Longmans, Green and Co. Price 6s. 6d.

Granites and our Granite Industries. By Geo. F. Harris, F.G.S., Membre de la Société Belge de Géologie, etc., with illustrations. London: Crosby Lockwood and Sons. Price 2s. 6d.

Poultry, for Exhibition, Home, and Market. With a Chapter on Pheasants and Pheasantries. By a Poultry Farmer. Superbly illustrated, with full page quarto plates. London: Swan Sonnenschein, Lowrey and Co. Price 3s. 6d.

The Pleasures of Life. By Sir John Lubbock, Bart., M.P., F.R.S., LL.D., D.C.L. Eighth and popular edition. London: Macmillan and Co. Price 1s.

Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

THE EXTINCTION OF INFECTIOUS DISEASES. — In his little pamphlet, entitled "National Strategy against Infection," Mr. Rollo Russell aims at the suppression and eventual extinction of the common infectious diseases, and he points out that no subject is less fitly local, or more completely national. It is highly probable that preventable diseases, such as hydrophobia, small-pox, scarlet fever, diphtheria, and typhoid, might, one and all, be exterminated if the public were less ignorant and indifferent, and if thorough measures were taken for their suppression. In Mr. Russell's opinion, we must have recourse to a well-organised body of men of science and practice to cope with those subtle hosts of misery and destruction known as infectious diseases and fevers. For this purpose he invokes State aid, and proposes a "Ministry of Health," a large number of county Boards, and 250 health officers, each aided by ten inspectors. The health officers are to be men of high scientific attainments, and as they are to be debarred from private practice, they are each to receive the modest stipend of £1,000 a year, and the inspectors £150.

It will thus be seen that the scheme of supervision and enlightenment is conceived in no niggard spirit, and we are far from saying that the money thus spent would not be well spent. It is probable, indeed, that a great diminution in disease would follow, and Mr. Russell estimates that, after paying all the expenses of the supervising staff, there would be a saving to the nation of nearly two millions per annum. In addition to this there would be the inestimable benefit of reducing the severe privation, suffering, and enfeeblement of this and succeeding generations. The force of this cannot be denied, and we fully appreciate Mr. Russell's good intentions; but we cannot help feeling that it would be a mistake to have a Government centre of organisation. There would soon be the inevitable system of routine, and doubtless householders would resent being under the peremptory orders of Government officials. All are agreed that sanitary reform is urgently needed in many directions, and that it should be based on the best hygienic teaching of the day. It will, however, be far better to encourage competent local authorities to take their share of responsibility, and to carry out such improved sanitary administration as may be necessary.

THE LIGHTING OF THE SUEZ CANAL.— It will be remembered that, contrary to the hopes and wishes of many advocates of electricity, the Canal Company decided to light the canal at night time by means of oil gas. Some interesting particulars have recently been published of the system adopted, and from these it appears that the whole length of the canal, as well as the Channel in the intervening lakes, are to be marked out by floating buoys or standard beacons carrying lights. The buoys are to be charged with compressed gas, in the same way as those which have for some time been used for lighting the roads of Port Said. The buoys are spherical, about ten feet in diameter, and each one contains enough compressed gas to serve a light continuously day and night for two months. The standard beacons are served from reservoirs of the same capacity as the buoys. The system cannot be said to be ideal, seeing that gas is to be burnt at the same rate during the day as at night-time; it has, however, been ascertained that the cost of lighting and extinguishing the lights daily would be much greater than that of the gas consumed during the day-time. The leading lights are to be white, while the channel lights

will be green on the Asiatic, and red on the African side of the canal. The gas will be made at the Company's existing works at Port Said, and all the arrangements are so far forward that it is expected the whole system will be in working order next autumn.

We believe that before coming to a decision on the very important question as to what system would best fulfil the requisite conditions, the Company very carefully considered various means of lighting by oil and electricity as well as by gas. Compressed gas carried the day so far as the lighting of the canal itself is concerned, but all vessels navigating at night are to carry electric lights. The forepart of each vessel must be provided with an electric projection lamp capable of throwing a light 1,200 meters; there must also be a shaded electric light suspended over the deck capable of illuminating a circular field about 200 metres in diameter. No steamer will be allowed to proceed at night time until the authorities at Port Said or Port Tewfik are satisfied that her lighting appliances fulfil the required conditions. In this way it is hoped that the present carrying power of the canal will be nearly doubled. This may be a somewhat sanguine view to take, as, however perfect the lighting appliances may be, they can hardly admit of traffic being carried on as quickly and as surely as by day-light. At least the new system will give great relief to the canal traffic, and will be welcomed by ship-owners.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In the East-end of London are some large warehouses in which are stored above 1,000 tons of flour. The guardians and proprietors of this considerable stock were alarmed last summer on discovering that a serious quantity had become changed into something more like dirty wool than respectable flour. One of the interested merchants was Mr. Sydney Klein, an earnest entomologist, who at once discovered the nature of the metamorphosis. He found that it was effected by a pretty and detestable little butterfly, which bears the name of *Ephestia Kühinella*, and is too well known in the ports of the Mediterranean where farinaceous matter is stored. A supply of these was imported with some of the flour, and the fond mothers of prospective offspring carefully provided for the babes they could not live to see by piercing the sacks, and each laying her hundreds of eggs therein, where food was provided in abundance. The eggs hatched into caterpillars, the happy creatures ate the rich food in which they were so luxuriously buried, pursued their wonted industry of spinning and weaving "until one entire warehouse was literally smothered, thousands of the larvæ on every sack, and many hundred pounds-worth of damage done; the flour was so interwoven with larvæ threads that it was rendered unfit even for pig or cattle food."

This occurred and continued in spite of systematic and scientific attack made under the superintendence of Mr. Klein. Fumigations with sulphur, hot liming of floors, ceiling, and walls, though killing immense numbers failed to overcome the enemy. The larvæ which reached full growth in about four weeks were seen in myriads crawling along the floor and up the walls until they reached the angle between walls and ceiling, where they spun their silken cocoons, in which they reposed until qualified for the parentage of new multitudes.

Mr. Klein then transplanted a colony to his house in order to study their habits, placing them in insect-breeding cages, and under large glass shades, but the young caterpillars squeezed through the meshes of the finest wire gauze, grovelled under the shades, and presently appeared in all parts of the house spinning cocoons in the upper corners of every room, after feeding on whatever farinaceous matter they could find. The remains of the colony were given by Mr. Klein to his fowls, and were devoured eagerly. This suggested another line of attack. A large number of fowls were placed in the warehouse. They consumed enormous quantities of the larvæ, but after about ten minutes' gorging became less energetic, and in the meantime the insects continued to increase and spread to other granaries in the neighbourhood, threatening the extinction of an important local industry. In July Mr. Klein had all the flour of one warehouse passed through fine sieves, and the larvæ and their refuse destroyed, but within a few weeks this flour was again swarming with grubs. Other able entomologists were consulted, but no effective remedy was forthcoming, when, to quote the words of Mr. Klein, "Science having failed to find a remedy it remained for Nature to step in with those wonderful antidotes which she always has in store for counteracting any over-production of the flora and fauna under her charge."

In August he observed some dark markings on the backs of the larvae, and in September an extraordinary change had occurred. The tops of the flour sacks were perfectly black, as though covered with soot. Close examination proved this to be due to enormous numbers of a small black fly, one of the *Ichneumonidæ*, specially constructed for depositing its eggs in the bodies of the young flour-eating caterpillars, wherein the eggs hatched to avenging maggots that fed upon the internal arrangements of the caterpillars, and finally leaving but a dead skin. The marks seen by Mr. Klein were due to these creatures in the maggot stage.

Mr. Klein concludes the paper that he read on the subject at the Middlesex Natural History and Science Society by admiring the proceedings of Nature who had thus "come to the rescue and provided a remedy herself." This admiration was evidently from a Corn Exchange point of view, not from that of the *Ephestia Kühinella*.

The *Ichneumon* appears to be a species new to science. The *Ephestia* were finally traced by Mr. Klein to some meal shipped from Fiume, on the Adriatic, over two years ago. As the moths did not appear until last summer, he attributes their extraordinary increase and ravages to the hot and dry summer.

Specimens of the imagos, pupæ, and larvæ of the *Ephestia Kühinella*, together with the extirpating *Ichneumonida*, are now displayed at the British Museum of Natural History, South Kensington.

Dr. Goldschneider has recently investigated the very curious fact that when carbonic acid gas of a given temperature is brought in contact with the skin, it appears much warmer than air of the same temperature. I well remember standing in the Grotta del Cane, and distinctly feeling the surface level of the pool of carbonic acid by the sensation of heat reaching a little above the knees. I then supposed the gas to be really hot, rising as it does from an active volcanic region. Doubtless others have observed the same and have arrived at similar conclusions, but it now appears that with the gas of the same temperature as the air above it, the warm-bath sensation would be felt up to the level of the gas, and that this is

not due to any actual objective rise of temperature of the skin, but is a sensory illusion due to hyperæsthesia or exaggerated excitement of the nerves that are specially connected with heat sensations.

Dr. Goldschneider found that a similar illusion is produced when the skin is in contact with air saturated with moisture, the difference being as much as 10° Fahr. between the sensations derived from fully saturated and semi-saturated air, *i.e.*, fully saturated air appeared to have the same temperature as semi-saturated air that was actually 10 degrees warmer.

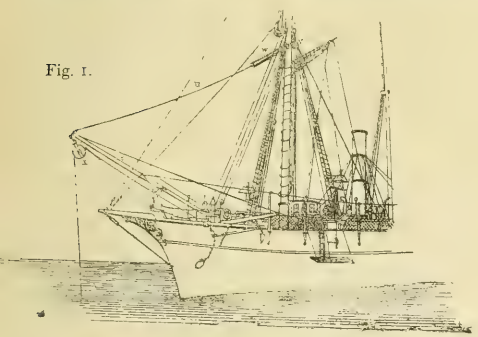
When on the subject of chlorine, I usually showed my pupils the experiment of plunging the hand into a jar of this gas. The sensation of heat in this case is very striking, and was then attributed to the chemical activity of the gas, inducing local oxidation of the blood in the capillaries similar to the action of chlorine in bleaching, but this is not the case with the carbonic acid nor with the aqueous vapour, as proved by experiments made by Dr. Goldschneider on the skin when exposed by removing the epidermis.

It does not appear that he has included the action of in chlorine in his vestigations. I am surprised at this, as there appears to be some connection between the phenomena, and the action of the chlorine—judging from my own sensations—is far more energetic than that of the carbonic acid. It may be that the chemical theory is erroneous, and that the chlorine merely stimulates the nerve, endings to produce the sensation of heat without effecting any actual rise of temperature.

MEASURING DEEP-SEA CURRENTS.

ON a former occasion* we described apparatus used for deep-sea sounding, and we now give a short account of the means adopted to measure the Gulf Stream currents.

Fig. 1.



For these particulars we are indebted to a report made to the United States Coast and Geodetic Survey Department by Lieutenant Pillsbury, U.S.N., who commanded the steamer *Blake*. His object was to anchor in the deep water of the Gulf Stream, and to observe the currents from the vessel so anchored. In the first place, therefore, he had to devise a method of anchoring the vessel expeditiously, with certainty, and with safety to the vessel and appliances. It was, moreover, absolutely necessary to relieve the sudden strain due to the motion of the vessel on the anchoring cable. To do this a heavy spar or boom *s* in Fig. 1 was attached by a goose neck to the pawl-bitt *t* in the bow, and this boom was held up by a steel wire rope *u* at an angle of about 45°. The wire rope then passed through a large block *v* at the mast-head, and thence through another large block on the deck, the same distance abaft the mast that the end of the boom was forward of it. At the end of the wire rope abaft the block was attached an arrangement of rubber buffers, about eight feet long, into which was hooked a powerful purchase. In this way it will be seen that upon any weight coming on the end of the boom

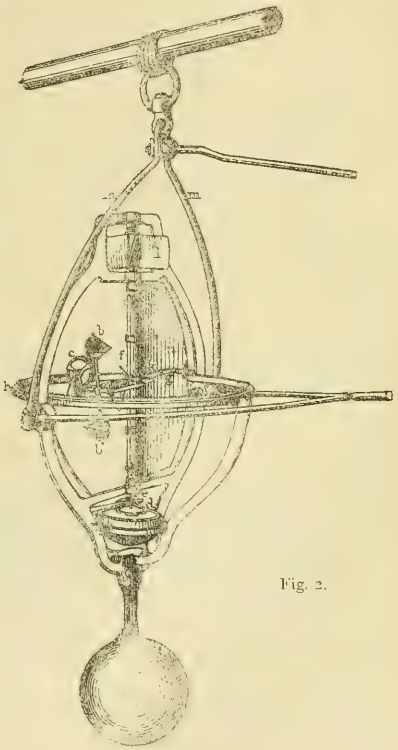


Fig. 2.

the strain was transferred by a straight thrust to the pawl-bitt, a straight thrust downwards on the mast, and a pull forward on the rubber buffers. This arrangement worked admirably with great strains; but the pitching of the vessel rendered it necessary to place the rubber accumulator *w* between the boom *s* and the point *v*. After this there was no trouble whatever.

The instrument devised by Lieutenant Pillsbury to obtain the strength and direction of the currents at any depth is shown in Fig. 2. There is a freely-moving rudder of thin metal *a*, and attached to this is a set of four metal cones *b*, placed at the extremities of two arms

* SCIENTIFIC NEWS, Vol. i., First Series, page 133.

or spokes, which are at right-angles to each other. The cones are attached to the arms in such a way that the centre of the base of each is equidistant from the centre of the spokes, so that when in the current the base of the cone above the axis is towards the current, and the apex of the cone is diametrically opposite. At the axis of the system is a small shaft, and by a worm on it differential wheels *c* are turned, and in this way the revolutions are registered.

Below the rudder is a compass bowl *d*, and a device by which the needle can be lifted and clamped at any time. The rod *f* performing this runs through the stem on which the rudder swings, and attached to the same rod is a system of levers *g*, which is fixed to the rudder and clamps its motion in a notched ring *h* surrounding the rudder. Attached to the levers are two horizontal wings or fins *k*, so arranged that, when the instrument is moving upward through the water, the pressure of the water on them clamps the rudder in the notched ring, and lifts the compass-needle, thus fixing the angle between the rudder and needle, and it remains fixed as long as the instrument has an upward motion. Above the rudder is a small propeller *l*, arranged in such a way that it will give downward motion to its shaft when the meter has upward motion. The shaft moves through the centre of the rudder-shaft, and communicates by a small stem to the fins and levers described. The office of this propeller is to lock the fins after they have already clamped the needle and rudder.

The whole arrangement is said to have worked well, the propeller locking when pulled through a distance of 15 fathoms at good speed. The apparatus is enclosed in a strong metal frame, which is hung in trunnions *m*, so that, by attaching a weight at its lower end *n*, it remains in a vertical position. In order to prevent the apparatus being swept astern by the force of the current, it was guided by a strong wire, which was sunk by means of weights, and kept in a suitable position by being attached by a line to the ship's anchoring rope.

The most serious difficulties with the meter were owing to the rusting of the compass-needle, although it was gold-plated, silver-plated, and covered with shellac. The needle became pitted, and lost its directive force somewhat, and this was corrected by remagnetising it by means of a dynamo machine on board the vessel. Much trouble was also caused by sea-nettles, with which at times the Gulf Stream abounds. In appearance these nettles are like sewing-silk, and if one of them became attached to the registering gear its motion was retarded.

It will be seen that Lieutenant Pillsbury exercised much ingenuity in the apparatus and working arrangements he devised, and those who care to know all the details of this interesting expedition cannot do better than read the whole of his report.

STRUCTURE AND PURPOSE.

IT may some day be admitted that the greatest of all the great qualities of Charles Darwin was his distinct realisation of the fact that animals and plants are actually alive. Of course we knew it before—in a certain sense; it was one of those imperfectly apprehended ideas, of which we scorn to be reminded, but which are not effectively our own. How men used to talk in the old days (say before 1860) of affinity and adaption! "Affinity" had detached itself from blood relationship; "adaption" had come to mean something which chiefly concerned men—most of all, men seated in professors' chairs or standing in pulpits. With Darwin came the impulse which has effectively taught us to regard animals and plants as things with a life and interests of their own—with what we must call their delights and their hardships: things capable of struggle and victory and defeat. It was really about this that mankind wanted to know, all the time that they were being put off with systems of classification and theories of morphology.

It is perhaps a bold thing to say that some of our most honoured and successful workers in biology have never, even down to this day, felt the influence of this productive conception. We doubt whether Herbert Spencer has; we doubt (and tremble as we doubt) whether Huxley has. The eloquent, fearless, and luminous Huxley, the originator of so many fruitful inquiries, the man who, above all others, won the popular mind to consider with attention *The Origin of Species*—does he not look upon animals mainly as material for dissection or morphological generalisation? If we say this, it is only to add instantly that two convictions, deeply planted, if not instinctive, give permanent worth to all Huxley's writings—a sense of duty towards mankind, and a sense of the *historical* value of facts. But how slight and occasional are his attempts to realise nature from any but the student's point of view. In his deservedly popular book on the crayfish, we have indications of real desire to penetrate the inner world of one living thing; but it is with an effort that he maintains the attitude, and he soon slips away into the well-accustomed paths of morphology.

Of the true spirit of the naturalist, born to observe living things and to read a life-history in slight external marks, White, of Selborne, is our purest, though by no means greatest, example. Conrad Sprengel had the same inspiration. Charles Darwin, among many still higher gifts, possessed this one to the full. Such insight into the living world exists unalloyed in many a schoolboy or rough country fellow; but in the end it is too often overpowered by neglect, or deliberately quenched by the spelling-book and Latin grammar. Whenever care is taken that the genuine and in-born love of living things shall get training and due recognition, natural history will grow apace.

We are far from maintaining that system and morphology are valueless. They are not only profitable, but indispensable. But they are not the highest. It is not for these that the genuine enthusiasm of the instinctive naturalist can be roused. They are helps to a higher and more stimulating study. They are to live natural history what grammar is to literature.

How can we indicate with any degree of precision the difference which appears to us so vital? Let us suppose that the seeds of plants are in question. One set of men will proceed very systematically, creating new and carefully-defined technical terms, and spreading a sort of logical net, so wide and so fine that no seed can fail to be entangled somewhere. If we question these investigators about a peculiar seed which happens to interest us, they will perhaps tell us that it is "solitary by arrest, with facial hilum, the embryo being curved round a starchy albumen." These and the like characters tell us as much as can be gathered from a

seed, as to the place of the plant in the botanical system. Further, they give information useful to the physiologist bent upon verifying an induction. But the child of nature turns a deaf ear; all this is nothing to him. Meanwhile a second teacher comes by, and shows how the seed grows, and how its tissues are fashioned out of simpler parts. We learn from him the laws of plant-development, as well as points of useful comparison between the flower and widely different organisms. Then some spark of interest is kindled; but still the born naturalist, whose devotion is an instinct rather than a form of intellectual curiosity, is only moderately roused. Last of all comes an interpreter of nature, to whom plants are neither material for glossaries, nor texts for parables, but creatures alive and busy, each the centre of its own little world. Darwin or Lubbock takes us by the hand, and at once we begin to sympathise. The seeds are no longer hard, round particles, but a brood of young ones. The plants are no longer mere members of certain natural orders, but far-away cousins, leading a life so unlike ours that it is hard to put ourselves in their place, but so like ours that only in this way can we truly understand a single detail of their structure. We are made to see how a tough and glossy skin may be a protection against drought; prickles a defence against browsing cattle; weels of hairs a defence against ants; scent and gay colours a fascination for bees; hooked fruits a means of transport by unwilling animals. We read, not without surprise at our former blindness, the open secrets of nature. We see one plant scattering its seed by explosion; another by triggers which release suddenly a slowly-accumulated strain; a third, by imitative arts, tempting the greedy bird to carry off what looks like a tasty beetle, while it is only a hard seed, which he will soon drop in disgust, but only after it has got well away from the spot where it grew. Even the winds are pressed into the service, and made to scatter the plumed seed of the dandelion or the winged seed of the pine. At length we realise that the plant is no dead, passive, and unalterable product of extinct forces, but a regenerative and plastic will, shaping new weapons for every new crisis, and taking advantage of every fresh opportunity by means of organs adapted from such materials as may chance to be ready at hand.

In these studies the lover of nature can at length find satisfaction. The correct use of technical words gave him no pleasure; analysis could not still his longings; the joy which he sought was such as an enthusiast of another kind draws from pictures or music. When he finds repose, it is because he "sees into the life of things," and shares the sensations of that creative mind whose thoughts are the phenomena of mankind.

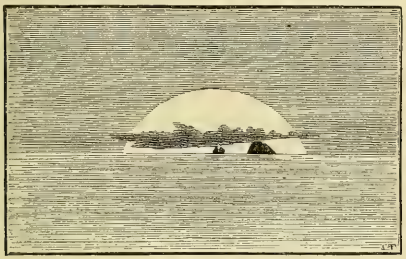


FIG. 1.

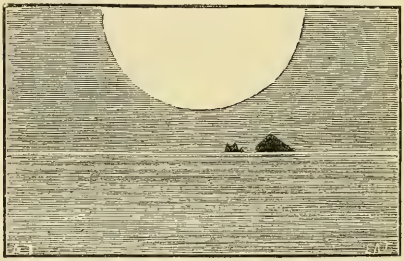


FIG. 2.

FIG. 3.

FIG. 4.

Canigou and Treize Vents, in the Pyrenees, as seen from Marseilles. Fig. 1, on February 10, 1888; Fig. 2, on February 11, at 5·20 p.m.; Fig. 3, on February 11, at 5·25 p.m.; Fig. 4, on February 11, at 5·45 p.m.

THE PYRENEES SEEN FROM MARSEILLES.

IN connection with the phenomena of the mirage which we have recently been considering, we may examine the occasional visibility of mountains, spires, etc., from points at which they are ordinarily hidden by the curvature of the surface of the globe. Of this a striking instance is given in *La Nature*, from which we borrow the accompanying illustrations. The geometrical extent of vision, that is, the semi-diameter of the circle enclosing that portion of the earth's surface visible from a given point, measures 11,602 feet at the height of 39 inches above the sea-level. At the height of 32½ feet the range of sight extends to 6¾ miles; and so on at greater elevations. From the summit of the Eiffel Tower at the Paris Exhibition, the

view will extend 37 miles, and from the summit of Mont Blanc more than 150 miles.

But this geometrical extent of horizon extending around us rarely coincides with the scope of distinct vision. Visibility at such great distances is exceptional and occurs only in a clear and pure atmosphere.

One of the most remarkable cases is that of the Pyrenees seen from Marseilles which presents a peculiar interest on account of the singular conditions under which it is produced.

Yearly, about February 10th and October 31st, Mount Canigou, situated in the Eastern Pyrenees, and of the elevation of 9,050 feet above the sea level, may be seen from Notre Dame de la Garde, projected against the disc of the sun at the moment of his setting.

The peak of Treize Vents, the height of which is below 9,000 feet, though more remote, is likewise visible to the left of Canigou.

From the summit of Marseille-Vyre, at nearly five miles to the south of Marseilles, the same observations may be made on February 13th and October 28th.

A straight line joining Notre Dame de la Garde to the apex of Canigou measures 253 kilometres, and passes about 390 feet below the surface of the Mediterranean, but the atmospheric refraction in consequence of which light is propagated in the lower strata of the air with a slight curve enables us nevertheless to perceive the Pyrenees.

Baron Zach first determined the chief conditions under which this phenomena is produced. On February 8th, 1808, from the eminences of Notre Dame de la Garde, the height of which is 161 metres, he saw for some minutes with a telescope Canigou projected in black against the clear ground of the sky when the sun had already disappeared below the horizon. M. L. Fabry, of the observatories of Paris and Nice, undertook some years ago the necessary observations, verified the observations of Zach, and indicated the dates at which the two Pyrenean summits may be seen projected on the disc of the setting sun. On October 31st, 1882, he observed the passage of Canigou before the solar disc from Notre Dame de la Garde, and on October 27th, 1886, from the summit of Marseille-Vyre, an elevation of 440 metres.

M. Marius Codd has likewise observed the visibility of Canigou from Notre Dame de la Garde, on October 30th, 1886. This year more complete observations have been made by M. Léotard, the secretary of the Scientific Society of Marseilles. On the 10th and 11th of February, Canigou and Treize Vents were seen as black masses on the brilliant ground of the western heavens. They were visible during about 25 minutes, and could be recognised, not merely with telescopes and opera-glasses, but even with the naked eye. In clear weather they would probably be visible for several days before and after the dates given.

Purification of Water.—According to Professor Leeds, of New York, water swarming with bacteria may be rendered almost entirely free from them by the addition of half a grain of alum to the gallon. This perfectly agrees with the experiments of Dr. Brautlecht, and is in harmony with the use of alum for the purification of suspicious waters in China, and the employment of salts of alumina in the treatment of sewage.

MINOR PHENOMENA OF THE ELECTRIC GLOW LAMP.

THE electric glow lamp has already been cited as giving an illustration of irradiation. When in full action, it presents no longer to the distant eye a simple loop of glowing carbon. By irradiation the outline is lost, and it resembles a gas flame. The same object illustrates very perfectly some of the phenomena of persistence of vision. The old example of the whirling ember, the thaumatrope and many other scientific toys, could be cited that are based upon this principle. It is also well known that if a spot of specific colour is looked at intently for some time and the eye is then turned upon a white surface, the complementarily coloured spectral image of the spot will appear. The nerves of the eye, it is assumed, become fatigued for the original tint, and hence, receiving white light, are affected by the residual colours. This is the reverse effect of persistence of vision. By the latter, properly speaking, the true image retains its effect. But the two are intimately related, as opposite effects so often are in the world of nature.

If an incandescent burner is gazed at while near the eye, the filament can be distinctly seen. Now, if the eye is closed, the image of the filament remains, and appears in clear outline in a purplish or violet colour. The characteristic shape of the particular filament is especially distinct. If, in looking at it, particular care is taken to avoid remembering its appearance (and this disciplining of the mnemonic faculty is not difficult), the spectral image seen with the closed eye will vividly portray the filament and its peculiarities. Sometimes it seems as if the effects of irradiation could be partly overcome; as if the image of a distant lamp could be reproduced free from the glow of irradiation. To a degree this may be possible, but a fully ignited and distant lamp always gives a confused spectral image to the closed eye.

The filament of the high resistance lamps illustrates elasticity very well. Surrounded by a vacuum, so as to be free from the damping effects of the air, no object more sensitive to vibrations or shocks can be found. The least tremor of the wall to which the lamps are attached makes the loop vibrate for a long period. This only takes place when they are cold. When the current is passing and they become red or white hot, they are no longer so elastic, and cannot be made to vibrate as before.

By the same vibrations sound is often produced. The vacuum of the globe prevents the sound from being heard by atmospheric transmission. But the filament is in solid connection with the globe and socket. If it is set in strong vibration, and the lamp is held pressed against the ear, a ringing metallic sound will be heard. This cannot be done with all burners. A certain size is naturally essential, as the sound is at best a weak one.

It would seem possible that a visual seismograph of extreme sensitiveness could be made on the general lines of an incandescent burner. It is probable that a filament could be obtained in this way more affected by external vibrations than is the most sensitive device now used.—*Scientific American.*

Electric Conductivity of Sulphur.—At common temperatures sulphur is a very bad conductor of electricity, but M. E. Duter (*Comptes Rendus*) has observed that at its melting point it conducts electricity fairly well.

General Notes.

Formation of Snow.—*La France* notes the formation of snow in a ball room at St. Petersburg. A window-pane had been broken, and the current of freezing air, rushing in rapidly, congealed the moisture in the air of the room, forming little snow-flocks.

New Minor Planet.—A new minor planet, No. 274, was discovered at 12 minutes past 11 on Tuesday night by Dr. Palisa, of Vienna, in Right Ascension 12h. 50min. 40 sec. (decreasing 48 sec. daily), North Polar distance, 89° 9′ 10″ (decreasing 5′ daily).

"Cigarette Heart."—According to the *Steven's Indicator*, of thirty-two young men of New York, lately examined for cadetships at West Point, only nine were accepted as bodily sound. The majority of the rejected candidates were said to have the "cigarette heart."

Masses of Native Silver.—A number of *pepitas* of native silver, according to *La Nature*, have been found in the Mexican State of Mechoacan. The largest weighed 606½ ozs. (troy), the others from 12 to 420 ozs. They were found in a calcareous formation mixed with limonite.

Bicarbonate of Soda in Milk.—Hitherto, according to *La Justice*, dairymen in France have been allowed to add bicarbonate of soda to milk, to make it keep better. This addition is now prohibited, as in certain cases lactate of soda is formed, which may have dangerously purgative effects upon young children.

The Planet Mars.—According to the researches of M. Perrotin, of Nice, this planet possesses an atmosphere not unlike our own. The formation and dissipation of clouds, and even the shadows which they cast upon the body of the planet, have been recognised. The same observer has studied those strange parallel marks, known as canals, discovered by Schiaparelli, some of which extend for 2,000 miles, but he can throw no light upon their nature and origin.

Globular Lightning.—*L'Astronomie* gives an account of this uncommon phenomenon as observed on board a ship on November 12th, 1887, at midnight, near Cape Race. An enormous ball of fire was seen to rise slowly from the sea to the height of seventeen or eighteen yards, and move against the wind. It stopped near the ship, and then changed its course to the south-east, and disappeared, after having been watched for about five minutes.

Exploration of Greenland.—Considerable attention is now being drawn to the proposed attempt of Dr. Nansen to cross the mainland of Greenland, from east to west, on snow-shoes. He will be accompanied by three or four athletes, all accustomed to the use of snow-shoes among the mountains of Northern Scandinavia. The greatest distance as yet penetrated into the interior of Greenland is only 140 miles. Eminences more than 6,000 feet above the sea-level have been already encountered in the previous attempts made by Professor Nordenskjold.

Moving an Hotel.—On page 176 we noticed the proposed removal of the Brighton Beach Hotel, Coney Island, New York, which had been imperilled by the encroachments of the sea. We now have to inform our readers that on the 7th inst. 120 railway cars having been placed below the hotel and its foundations having been removed, locomotives were attached and the building was carried a distance of 100 feet inland. The difficulty of this engineering feat will be understood when we say that the hotel covered an area of 92,000 square feet (about two acres), and weighed 5,000 tons.

Discovery of Iron Ore in Algeria.—Discoveries of iron ore deposits have been made in Algeria, in the province of Oran, which are reported by the experts sent to investigate the matter to be of great value, rivalling the famous deposits of Mokta-el-Hadid. The ore averages 65 per cent. of iron. The deposits, which are of large extent, are situated within seven miles of the railway station of Bou-Tlelis, at the mouth of the Madagre river, where there is a good harbour and facilities for shipping the ore. This discovery is likely to be of immense importance to the French iron industry.—*Industries*.

Glass-cutting by Electricity.—The cutting of glass tubes of wide diameter is another of the almost innumerable industrial applications of electricity. The tube is surrounded with fine wire, and the extremities of the latter are put in communication with a source of electricity, and it is of course necessary that the wire adhere closely to the glass. When a current is passed through the wire, the latter becomes red hot and heats the glass beneath it, and a single drop of water deposited on the heated place will cause a clean breakage of the glass at that point. Contrary to what takes place with the usual processes in the treatment of this frangible material, it is found that the thicker the sides of the tube are the better the experiment succeeds.

People's Lectures.—The remarkable success of these lectures was maintained on the 16th ult., at Walthamstow, where the first lecture of a course on "The Atmosphere" was given by Mr. V. B. Lewes, at the Town Hall, which was crowded in every part. The initiative in obtaining the lectures was taken by the Local Board, and there is every prospect that a permanent centre will be formed in connection with the Society for the Extension of University Teaching as a result of these lectures. This course is the twelfth and last course of people's lectures to be given during the present session. The results of the experiment have been so satisfactory that the work will probably be continued next winter on a still larger scale.

A New Gas.—The Local Board of Dalton-in-Furness recently determined to experiment at Askam-in-Furness with a new gas for the purposes of street lighting, house illumination, etc., and with this view put down a Stockport patent apparatus for the production of gas from scrap iron and sulphuric acid. The new gas was produced on Good Friday for the first time, and the streets were brilliantly lighted. The light is bright and steady, and of great illuminating power. So far as can be seen the novel experiment is a great success; but experience alone can determine whether it will prove financially economical. The patentees, however, claim that it is much cheaper and more effective than ordinary coal gas.—*Industries*.

Detection of the Presence of Organic Matter in Drinking Water. — This process depends on the reduction of salts of silver in contact with organic matter on exposure to the light of the sun. We put, says *Cosmos*, into a stoppered bottle of clear white glass, and capable of containing one pint, half a pint of the water in question. To it are then added 100 grain measures of a neutral solution of nitrate of silver, containing five per cent. of the solid salt. The bottle is stoppered and set in the sun until all the silver is reduced, which may take from twelve hours to five days. When the water becomes clear, it is filtered, and washed first with distilled water and then with ammonia. If anything remains undissolved, organic matter is present in the water.

A New Sugar Cane.—For about 100 years most of the sugar in the West India Islands has been obtained from the Otaheite cane, originally brought from the Pacific Islands by Captain Bligh in His Majesty's ships in 1796. Latterly strenuous efforts have been made to introduce new canes in the hope that they would prove richer in yield of sugar. In one instance we learn that a cane introduced by the present Assistant-Director of Kew Gardens when in charge of the Botanical Gardens at Jamaica has supplanted the Otaheite cane and proved most productive. A planter at St. Kitts says the new cane, which he has called the Jamaican, is a "marvellous cane." He adds that "it stands dry weather well, and is entirely superseding the Otaheite cane."—*Times*.

Experiments on Milk and Butter.—At the New York Dairy and Cattle Show in May last, it appears that the prizes for largest quantity of milk and of butter produced were awarded to Holstein cows in opposition to Jersey cows. It appears, however, that whilst on an average 30·52 lbs. of the milk of Holstein cows was required to yield 1 lb. of butter, only 20·11 lbs. of that of the Jersey cows produced the same quantity. Hence the milk of the Jerseys is richer by one part in three. No analysis of the milk was made. On analysing the butters, the mean proportion of water in the Holsteins was found to be 18·90, whilst that in the Jerseys was only 16·63 per cent. The proportion of milk and butter yielded to the total weight of each cow and to the quantity of food consumed is not stated—two very important items.

The Action of Manures.—M. Berthelot concludes (*Comptes Rendus*) that the addition to the soil of phosphatic manures, and to a certain extent even that of nitrogenous fertilisers, after the normal time of flowering of the crop seem useless, or, at least, of small value, whilst the addition of potassic manures may render service nearly up to the end of the season of vegetation, seeing that potash continues to be absorbed and to act as long as the formation of woody matter is in progress, even during the period of fructification. He adds that phosphatic manures act upon the vegetation of the season only by that portion which is immediately soluble, and which is assimilable before flowering. The effects of the portions which are only gradually attacked by earthy and terrestrial agents seem to be postponed for the crops of succeeding seasons.

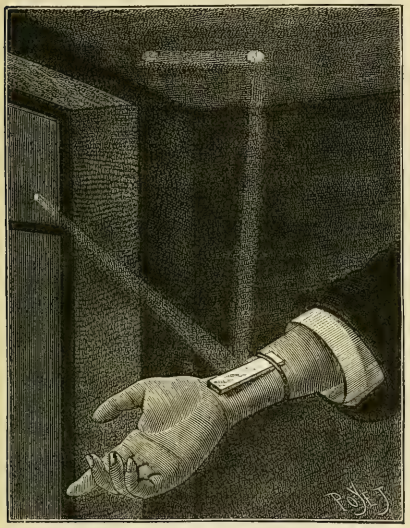
Carbons for Arc Lamps.—The manufacture of arc light carbons forms an industry of considerable magnitude, and the works of Herr Hardtmuth, in Döbling, are now turning out about 3,500 metres of carbons daily. Some improvements have recently been made in the process of manufacture, by which the homogeneity and density of the carbons are increased. These refer more especially to cored carbons. As usual, the rod of plastic material issues from the press in the form of a tube, and after drying and baking the carbons are steeped in a heavy hydrocarbon, by which the pores left after the first baking are filled. The carbons are again baked, and the core is then inserted under a pressure not much greater than that of the weight of the plastic mass forming the core. In connection with this factory is a well equipped electrical laboratory for the testing of arc lamps. There are dynamo machines by various makers, viz., Pöge, of Chemnitz; Kremenezky, Mayer, and Co., of Vienna; Krizik, of Prague; and Siemens and Halske (alternator). The reason for installing various dynamos is to be able to test any lamp which may be sent to the laboratory. There is also a spectroscope for determining the elements contained in the carbon from the spectrum of the arc, and the laboratory is equipped with the usual electrical measuring instruments and photometers. The work at this laboratory is done on a thoroughly scientific basis, and both lamps and carbons are tested so as to determine the best quality of carbon to be used for each type of lamp. At the forthcoming Jubilee Exhibition Hardtmuth carbons will be largely used for the arc lamps. —*Industries*.

Insulating Cement.—According to the *Moniteur Industriel*, the Director of the Vesuvius Observatory possesses an electrometer which is supposed to be the most perfect instrument of its kind. It was in reference to this instrument that M. Mascart observed, at the Meteorological Congress held in Rome—"So perfect is it that it might serve to control the indications of all other instruments of the same class in the world." This superiority is said to be due to the material with which the insulation is effected, viz., a cement formed of pitch from Greece (*poix grecque*), two parts; and calcined plaster, one part. The plaster in question, termed in Italian *scagliola*, is pure gypsum, which has been raised to a high temperature and thus deprived of half its water of constitution. It is a superior kind of plaster of Paris, and, when mixed with water, hardens after combining with the proportion of this fluid which had been expelled by heat. The cement formed by admixture of the pitch with this plaster (presumably in the semi-dehydrated condition) is, when hot, a homogeneous viscid paste; it may be applied to apparatus by means of a brush, or it may be cast in moulds of any required form. It possesses the insulating properties of ebonite, but is softer and more plastic. A skilful manipulator can turn and polish it in the lathe. In colour it is slightly darker than amber. From the electrical point of view, its characteristic and useful property is that it retains its insulating power, whether it be exposed to a high temperature or a moist atmosphere. We may add to the above that, at the period when Peltier's or Milner's electrometer was in common use for testing the insulation of cables, we obtained the most perfect insulation with a cement composed of shellac, gum dammar, and paraffin wax.

ECONOMICAL SPHYGMOGRAPHS.

IN order to make the beats of the pulse or of the heart manifest to the eye, an apparatus is used named a sphygmograph. Of this instrument there are several modifications. Some, like that of Dr. Marey, are self-registering and consequently high-priced. For some time we have observed, says *La Nature*, a small apparatus at the exceedingly modest price of 2½d., which in most cases gives very satisfactory indications. It is formed of a slender brass wire bent back for part of its length and coiled in a spiral, the last coil being soldered to a small metal cup. The other portion, which is left straight, bears a little flag at its summit.

To make use of this instrument, it is placed over the artery whose beats are to be shown, when the wire supporting the flag begins to oscillate in a very



perceptible manner. The amplitude and the frequency of the oscillations vary, of course, with the persons submitted to observation.

If it be required to show the pulsations to a numerous audience, it is necessary, in order to increase them sufficiently, to have a long, light, oscillating rod, a condition not easily fulfilled in practice. M. Arthur Good substitutes, therefore, for a rod a pencil of light, which traces the movements of the pulse on the wall or the ceiling of a dark room, as in the accompanying figure. This pencil of light may be admitted through a hole in the shutters, or it may be obtained from an artificial source. In either case it is directed upon a small mirror fixed in a bracelet of caoutchouc, when a reflected image is thrown upon the ceiling. Owing to the imperceptible movements which the pulse impresses upon the mirror, we may follow the oscillations of the reflected ray as easily as those of a rigid rod, and we see the image on the ceiling changing its place with more or less rapidity according to the rate of the pulse in the person under observation. In hospitals an analogous method is sometimes used to render the pulsations visible, a small slip of paper being pasted over the artery to be studied. The apparatus first described is entirely of metal, and with it it is easy to render the movements of the artery audible. It is merely necessary to solder a copper wire to the cap which supports the spiral, and then to connect this wire to one of the poles of a Leclanché cell. The other pole of this element is connected by a second wire to a small brass rod fixed by a bracelet upon the arm of the patient, so that at each oscillation the rod which carries the flag may impinge upon it. If a telephone is introduced into the circuit thus formed, a click is heard in the instrument at each pulsation.

NEW METHOD OF COUNTING AIR-GERMS.

IN a previous number (p. 304) we gave an outline sketch of the methods adopted by Pasteur, Tyndall, Miquel, Koch, and Hesse, for ascertaining the number of microoganisms in a definite quantity of air. Dr. P. F. Frankland has contributed a very able paper to the Royal Society, in which he describes a new method of determining these microbes. The tubes through which the air under examination is aspirated are about 5 inches in length, and ¼ inch internal diameter. One end is slightly constricted, and a plug of cotton wool, loosely packed, is forced down to the constricted part from the other end of the tube. About an inch from the constricted end the tube is again constricted, so as to support a plug of fine sugar or glass powder (passed through sieve of 40 meshes to the linear inch), which has been pushed in from the open end of the tube. This plug is supported in front and behind by a layer of glass-wool, either plain or coated with sugar. About an inch from the open end, the tube is again constricted to form a support for the important plug which has to catch the germs as they are being drawn in with the aspirated air. This plug is constructed of a small quantity either of ordinary glass-wool or of glass-wool which has been previously coated with cane-sugar, by soaking it in a saturated solution of the latter and then drying. Each of these plugs is about the size of a pea, and with a little practice the packing can be easily arranged to give the necessary degree of imperviousness. The last plug—the one nearest the open end of the tube—is invariably made more pervious than the middle one, so that any organisms which may be carried by the current of air through it may find a greater resistance in the second. If the second plug is afterwards found to be altogether free from organisms, it clearly shows that they must have all been arrested by the first plug.

The tubes thus fitted are sterilised by being heated on three successive days, for several hours each day, to a temperature of 230° Fahr. in the case of those containing sugar, and to 320° Fahr. in the case of those which only contain glass plugs. A number of tubes may be conveniently sterilised at one time in a tin box. In this way several tubes can be carried about without fear of contamination to the place where the experiment is to be performed.

The sterilised tube is at the place of observation carefully taken from the box, and is handled by the

plugged and constricted extremity. That end is then attached by means of a piece of stout india-rubber tubing to a piece of lead tubing about 10 feet in length, which is clamped at this end to a retort stand, whilst the other extremity of the lead tube is attached to an exhausting syringe, which is mounted on a rigid support placed upon the ground. By bending the lead tubing the glass experimental tube is brought into a horizontal position, and in out-of-door experiments the open extremity is turned away at an angle of 45° from the direction of the wind. An ordinary mercury pressure gauge is also attached to the lead tubing, and properly supported on the ground. A mirror is placed obliquely on the ground to enable the operator to watch the rise and fall of the mercury in this pressure gauge.

After each upward stroke of the pump, the experimentalist waits until the pressure is equalised before making the down stroke. In this way each stroke of the pump corresponds to the passage through the experimental tube of a definite quantity of air. The number of strokes measures the volume of air aspirated, and the number of strokes per minute indicates the degree of perviousness which the plugs possess. In Dr. Frankland's apparatus, one stroke of the air-pump was equivalent to 18 cubic inches. The volume of air aspirated was varied according to the number of micro-organisms supposed to be present, but with ordinary London air 60 strokes of the pump were found to be convenient.

Dr. Frankland employed the system of flask cultivation for the treatment of the experimental plugs. These were of carafe shape, and of 20 to 25 cubic inches capacity, containing about ½ cubic inch of gelatine-peptone, all being properly sterilised and having cotton-wool stoppers. The gelatine in these flasks has been melted at a temperature of 86° Fahr. The tube through which air to be tested has been aspirated is withdrawn from the sterile box, care being taken to handle it by the plugged extremity. A scratch is made with a file about the middle of the tube, and the tube carefully broken across. The half containing the two plugs is carefully laid aside on a sterile support; but the other half with the experimental plug is held between the thumb and first finger at the constricted part, and the broken edge passed two or three times through a Bunsen flame, care being taken that the heat does not reach the plug. The cotton-wool stopper of one of the gelatine flasks is then withdrawn, and the open extremity of the tube is held vertically over the open flask, whilst the plug is carefully pushed down by means of a strong piece of sterilised copper wire, introduced from behind through the broken part of the tube.

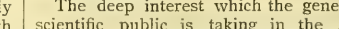
The plug having been thus forced into the flask, the cotton-wool stopper is replaced. A similar process is gone through with the second plug. The gelatine in each flask is then agitated with the plug by means of a rotatory movement. In a few minutes the plug is quite broken up. The flask is now held almost horizontally under a stream of water, and by uniformly rotating it an almost perfectly even film of gelatine is spread over its inner surface. The stream of water must be sufficiently cold to prevent the gelatine from forming lumps.

The flasks, thus coated internally with the film of gelatine and germs, are allowed to remain for an hour or so in a cool place. They are then placed under a bell-jar, the internal air of which is kept saturated with moisture by means of blotting-paper soaked in water. The contents of the flasks are allowed to incubate at a temperature of about 70° Fahr. for a period of four or five days. The counting of the colonies after incubation is effected with great ease by dividing the flasks with ink into segments, and holding them up against the light.

Dr. Frankland has found that the organisms are almost invariably arrested by the first plug, the second plug only occasionally yielding any, though it was far more impervious than the first. It seems, therefore, that experiments can be quite successfully made with a one-plug apparatus, which will save much time and expense. He found, among hundreds of recorded experiments, that at St. Paul's Cathedral there were 30 colonies of micro-organisms in a cubic foot of air from the Golden Gallery, 120 colonies per cubic foot of air from the Stone Gallery, and 140 from the air of the churchyard.

Dr. Frankland considers his new method to have several advantages over Hesse's best process. It possesses all the well-recognised advantages pertaining to the use of a solid cultivating medium. The results can lay claim to a higher degree of quantitative accuracy. The results are not appreciably affected by aërial currents, which prove such a disturbing factor in the results obtained by some other methods. The collection of an adequate sample of air occupies a much shorter space of time. Thus, whilst the aspiration of a cubic foot of air through Hesse's apparatus takes about 2¼ hours, by the new method it only takes about half-an-hour. As the whole plug upon which the organisms from a given volume of air are deposited is submitted to cultivation without subdivision, no error is introduced through the multiplication of results obtained from aliquot parts. The risk of aërial contamination in the process of flask-cultivation is practically nothing. The apparatus being very simple and easily carried, the method is admirably adapted for the performance of experiments at a distance from the laboratory.

The deep interest which the general as well as the scientific public is taking in the subject of micro-organisms in the air is a sufficient excuse for the detailed explanations of the several methods of quantitative enumeration which we have abridged from Dr. Frankland's excellent communication.



Cutlass Tests.—In order to more completely insure the good quality of the cutlasses issued to the Navy, orders have recently been given for the following tests to be applied to a large number of the weapons, which are to be repointed and reduced to a uniform blade length of twenty-seven inches. First the cutlass is to be subjected to a direct vertical pressure on the hilt in a machine specially constructed for the purpose, and it is required to stand a pressure of 40 lb. without deviating from the straight line. Then additional vertical pressure is to be applied in the machine until the cutlass is bent, so that the distance from point to hilt is reduced three inches. Finally, the blade has to be bent round a suitable curved block, so that every portion of it partakes of the bend, the distance from point to hilt being reduced two and a half inches. The cutlass also has to be struck with moderate force, back and edge, on a block of oak, to test the soundness of the hilt.

Natural History.

WHAT IS THE DUCKBILL?

WHAT is the Duckbill? That is a question which caused great perplexity in the days when the animal was first discovered; it is a question which causes equal perplexity now. Where in the zoological scale are we to place a creature which so strangely unites in its own person the characteristics both of birds and of mammals, and yet appears definitely to belong to neither group? How are we to account for the various discrepancies with which it presents us?

In outward appearance it is a mammal. True; but its skeleton is far more the skeleton of a bird. We find, for example, that it possesses a distinct furcular bone, or "merry thought," in addition to what are apparently the true clavicles, or collar-bones; and these latter, upon closer examination, we find, developed in no little degree, to be the coracoid bones which are so prominent in the skeleton of a bird. The skull and the bones connected with it, again, closely resemble those of a duck, just as does the outward appearance of the head; and the sternal ribs are ossified; and a spur runs from the hinder foot of the male, analogous to that with which we are familiar in the case of the game-cock and many of its allies. The limbs, of course, are very different, although the general principle of their structure is the same. The anterior pair are not modified into wings, neither are the hinder pair suited for perching, for wading, or for running. Yet even these latter members are strikingly similar to those of the swimming birds, save and except that they are also adapted for scraping and shovelling away the earth through which their owner is accustomed to burrow.

On the other hand, it is clear enough that the animal does not and never did fly, that it is clothed with hair and not with feathers, and that it suckles its young. And these facts were formerly considered as sufficient to determine its position among the mammals. But later discoveries almost compel us to modify this conclusion. Geology, for example, shows us that certain reptiles in days of old were feathered; and thus vanishes the one essential point of difference which was believed in all cases to hold good. We must now admit, as Mr. Grant Allen shows us, that birds are merely modified reptiles it almost seems as if we shall also be compelled to admit that mammals are merely modified birds. For the still

more startling fact has been recently brought to light by unimpeachable authority that the duckbill lays eggs, an operation hitherto held to be the exclusive prerogative of creatures below the mammalian rank. "All life from the egg" is certainly, and long has been, a scientific axiom, but it has nevertheless been considered, in the case of mammals, to apply to the embryo only, and not to the young when actually brought into the world. Yet the duckbill, most puzzling of contradictions, sets our supposed law of Nature at defiance, and usurps, as it were, the distinctive functions of creatures to which it has been adjudged not to belong. The eggs are quickly hatched, it is true, but still as eggs they are laid; how are we to overcome the testimony of this fact?

"The essential character," says a well-known authority, "whereby the class of mammals is distinguished from all others is that the creatures composing it bring forth living young, which they suckle, and thus nourish for a time with their milk." But the duckbill, as we have seen, does *not* bring forth living young, although it undoubtedly nourishes its offspring, when they leave the protecting egg-shell, with its milk. Are we, then, to relegate it to the class of the birds? If so, how is the existence of mammary glands and teats to be accounted for? Are we to retain it among the mammals? If so, how are we to describe the distinguishing features of that group? Are we to adopt a middle course, and consider it as a connecting link between the two classes? If so, surely the whole theory of classes vanishes altogether, and we can only look upon the animal kingdom as one vast tribe, indivisible into smaller groups of marked and distinctive characters. Mammals, birds, reptiles, fishes, all the old familiar divisions must go, and our system of classification must be entirely reorganised, in accordance with facts to whose bearing and importance we can no longer shut our eyes.

This view of the question is strongly upheld by the discoveries of the last three or four decades. The colugo, or flying lemur, is clearly a connecting link between the monkeys and the bats, and we can no longer regard those so-called orders as truly distinct. The chetah, or hunting leopard, as clearly connects the cats with the dogs. The mud-fish, or lepidosiren, is at least as much a fish as a reptile, and Mr. A. G. Butler has lately proved that there is no real and unvarying distinction which can be relied upon to separate the butterflies from the moths. The *Amphioxus*, again, is one of the most anomalous of living creatures, being, practically speaking, a vertebrate animal without a skeleton; and for all that we can tell to the contrary, we may yet meet with some mollusc-like fish, or fish-like mollusc, more strictly intermediate still between the two primary divisions of the animal kingdom.

Even if it be not now existent, geology may supply us with it, just as it has already supplied the connection between many groups of animals which to-day seem perfectly distinct. Transitional forms appear always to be physically weak. The colugo is weak, the chetah is weak—comparatively speaking—the duckbill is weak, and the *Amphioxus* is weak. Hence such forms are more prone to die out, less able to hold their own in the struggle for existence than others possessing in more marked degree the characters of the order to which they belong, and more specially adapted to their surroundings. And hence, consequently, the gaps between classes, ribes, orders, and families are very probably in all cases more apparent than real, and in many are certainly bridged over by creatures still existing, or by others which have existed at some more or less remote period in the past. Of the former, the duckbill is undoubtedly our most striking example. It is, as far as any animal can be, exactly midway between two of the most important classes in our present system of classification. And thus it serves, beyond a doubt, to merge the one into the other, and to show us that we have still very much to discover in the field of comparative anatomy.

For ordinary, every-day employment, our present zoological terms will doubtless live; considered in their relation to scientific phraseology, they will as certainly perish. Just as we have discarded the nomenclature and the classification of our forefathers, so will our descendants discard ours. And it is such discoveries as this concerning the egg-laying propensities of the duckbill which prove to us beyond a doubt how assuredly our system is doomed.

[We may here add a fact which, while it tends to separate the duckbill from mammalia, connects it rather with reptiles than with birds: its body has the low temperature of 76·8° Fahr., that of the mammalia being on the average 101° Fahr.—Ed. *S. N.*]

A Village of Beavers.—One of the few colonies of beavers to be seen in Europe is that at Amlid, near Christiansand, in Norway. Sometimes a dozen of these animals may be seen at once disporting themselves in the water. Their huts are built at the edge of the stream, and are two stories in height, one above and the other below the water. The walls are made of thick logs, and the roofs of sticks and clay. The beavers have cut down all the aspens in the neighbourhood, and are beginning to attack the birch-trees. They cut trees of more than eighteen inches in diameter off at the base. The branches are dragged down to the water along real roads or slides, which are cleared of any roots which might be in the way. Sentinels are posted to give the alarm in case of danger, when all the beavers take to the water.

Cunning of the Fox.—Dr. J. F. Landrey, in *Popular Science News*, relates the following, showing the wonderful sagacity of the fox:—On the Lower Wabash a company of hunters from Tippecanoe county encamped for the night among the cavernous limestone hills occasionally found in those regions. The hounds soon traced up the retreat of an old grey fox and her family in one of those narrow crevices that probably led into a more open cavern further in. The whining of the young foxes was very distinct, and led to louder brayings of the hounds. The mother, however, was "not at home." But it was not long before her barking was heard beyond the camp on a small hill in another direction. The dogs soon took the hint, and gave her a magnificent chase around the hill. Doubling on her track, she eluded the dogs, returned to her cubs, and either carried or induced them to follow her into the deeper recesses of the cavern, beyond the dangers of digging and chasing. I have often thought that little piece of strategy a masterly piece of generalship. What could be more natural than to desire to draw away from her young ones the threatening dogs and men? Seeming to know that her own barking would have the desired effect of diverting their attention to larger game in an open field, she ventured to draw their attack upon herself, and

succeeded in saving the lives both of herself and her young ones.

Poisonous Fishes.—F. Day (*Field*) gives a formidable list of poisonous fishes. Some species appear to be always dangerous, some become unwholesome at certain seasons of the year only, and others, again, when they have been feeding on star-fishes, sea-urchins, sea-cucumbers, or on putrid matter.

Whales in the Mediterranean.—According to M.M. Pouchet and Beauregard (*Comptes Rendus*), two whales (*Balaena biscayensis*) have been recently seen off Algiers. One of them was captured between Castilione and Tipaza, and was found to measure 11 metres in length and 6·6 in circumference. This is only the second occasion of such whales having been seen in the Mediterranean.

Colouring Matter of *Huechys Sanguinea*.—M. A. Fumouze (*Comptes Rendus*), on examining this insect, which belongs to the hemipterous order, and is closely allied to the cicadas, finds in them a fat, a wax, an oil, an odoriferous matter, a yellow substance which approaches the gum-resins of the vegetable world, and a red colouring matter. The colour is soluble in water, insoluble in alcohol, ether, and chloroform, soluble in alkalis with a red colour. The watery solution, if treated with acetate of lead, gives a fine red precipitate. The insolubility of this colour in alcohol distinguishes it from carminic acid, the pigment of cochineal.

To Preserve Fish Alive out of Water.—*La Science en Famille* is responsible for the following process:—Take a crumb of bread steeped in good brandy, knead it into a paste, and fill the throat of the fish with it; pour upon it a small quantity of the same brandy, and wrap up the fish in a sufficient quantity of straw, taking care not to injure it. It may thus be kept alive during a journey of ten to twelve days. Afterwards it is merely necessary to put it in cold water, when the torpidity into which it was thrown by the brandy passes off, and in a few hours it becomes quite lively.

The Insect Pests of India.—Under this title the *Globe* enlarges on the recent proposal of Mr. E. Cotes, of the Indian Museum, Calcutta, that the collection of full and trustworthy intelligence concerning the destructive insects of India should be forthwith taken in hand. The number and variety of these tiny enemies, and the extent of their ravages, render this investigation an Imperial duty, since the people are not only impoverished by the ravages of these pests, but even positive famine is not unfrequently produced. The success of the operations carried on in this direction are at once an encouragement and a guide. A thorough history of the life-history of the destructive insects is necessary, so that planters and farmers may learn how and when they may be attacked with the greatest prospect of success.

The Cabbage Butterfly in America.—This common field-pest, *Pieris rapæ*, according to Mr. S. H. Scudder (*American Naturalist*), was first introduced into America about 1860, and has now spread over a very large part of the United States. In its southern extension it has apparently found a natural limit about Jacksonville in Florida.

ACCLIMATISATION.—II.

(*Continued from page* 294.)

THE latter part of the above proposition is merely an extension of the acute observation of Dean Herbert that we do not, of necessity, always find plants growing in the soil best suited for their wants, but often, rather, where they are most secure from the encroachments of rival species.

Our next observation may, possibly, be misconstrued into an avowal of pessimism. There are very few instances of a beautiful, a useful, or even a harmless plant or animal being accidentally introduced into any country, or having been purposely introduced and yet proving able to dispense afterwards with man's care and protection. On the contrary, the species most commonly and most easily introduced are weeds and vermin.

If a definition of "weeds" and of "vermin" be asked for, we may say that both are organisms which satisfy neither our æsthetic nor our economic wants, and which are often actively injurious to our persons or property. Decided beauty may make us overlook uselessness, and manifest utility makes us condone ugliness. But the injurious plant and the harmful animal, even if beautiful, a very rare case, are invariably written down in our *Index expurgatorius*. There is, of course, scope for some little difference of opinion as to what species are ugly and which are hurtful.

A modern writer has gone so far as to sneer at the "morning glory," to pronounce our taste in flowers as "barbarous," and to term the *Gloxinia* "unlovely." But such dissidences, born of sensationalism, do not affect the general principle.

We have yet to look a little further. To the very essence of a weed or a vermin belong, great reproductive power, tenacity of life, and adaptability to varying conditions. But for these last attributes ugliness and uselessness would escape notice and even positive hurtfulness would be practically neutralised. The misfortune is that beautiful and useful organisms rarely possess these features in any marked extent, whilst ugly, useless, or pernicious species manifest them very strongly. Surely a grim satire on the "survival of the fittest!" Is it possible that the elaboration of the higher colours, reds, purples, violets, and blues, is a greater strain upon the resources of a plant than the production of yellows, or than the total absence of a coloured corolla or calyx? Is in like manner the generation of perfumes an exhaustive demand? Every one must have noticed that none of our normal weeds give out a perfume, and that the entire order *Compositæ* is singularly poor in this respect, being either scentless or positively malodorous.

In short, whatsoever we would wish to destroy survives, sets us at defiance, and spreads round the globe like a pestilence. Whatsoever we seek to preserve taxes our constant efforts, and rarely, very rarely indeed, succeeds in spreading spontaneously into new regions. There are beautiful plants, such as the lily of the valley, and the choicer ferns, which are assuredly disappearing from the British flora.

In like manner the roller, the golden oriole, the bee-eater, and the wax-wing have vanished from our fauna, and the kingfisher, the jay, the woodpecker, and the goldfinch are surely following them. We little need ask, therefore, why such species do not attend the footsteps of our colonising pioneers.

It may be said that lovely flowers, birds, and insects

are extirpated on account of their beauty. Careful examination will show that such is not the case. Certainly lilies of the valley growing in our woods are carried off for sale wherever seen. But a far wider devastation is experienced by the groundsel, the thistle, the dock, and the dandelion. Every gardener, from the extensive nurseryman to the humblest amateur, wages war on these weeds unceasingly. So does every farmer. They have also their natural enemies among birds and insects. But instead of decreasing we may feel thankful if they are not gaining ground. A persecution a hundred-fold more severe than that which overpowers the lily of the valley leaves them unhurt.

It is surely a difficult task to say why and how tenacity and the power of multiplication are thus apparently at least, preferentially linked with ugliness and hurtfulness.

The main peril of naturalising any species lies in the circumstance that we can rarely judge how its habits and its powers may be modified by novel surroundings. We know now that the diet and the rate of increase of an animal are not constant points immutably fixed, but are open to change. If a destructive insect be conveyed to a climate where the summer is longer and less fickle, it may produce an additional brood of descendants every season. European entomologists are apt to smile at the notion of *Chærocampa celerio* as a vineyard pest. Yet this result has been reached in California.

A still more frequent cause is that a species in its original home may have been kept in check by some parasite or other destroyer. But when transferred to another hemisphere these enemies may not have accompanied it. Hence its increase is for a time, at least, unbounded. Not a few of the most destructive insects in the Atlantic States of the American Union are old familiar denizens of Europe, and have here done comparatively little damage. But when introduced into fresh fields and pastures new they have multiplied in a manner previously unimagined.

Herewith is connected a curious fact:—The animals, the plants, and the diseases of the eastern continent have a much greater tendency to become cosmopolitan than those of America and Australia. A goodly number of European plants—substantially all of them vile weeds—have reached California, Australia, and New Zealand, have there become wild, and are to a lamentable extent displacing the much more interesting native vegetation. But the instances of an American plant having become naturalised in any part of Europe are rare. And so far, we think that no Australian plant has penetrated into Europe save under cultivation. Here, of course, the winter's cold is an additional hindrance. In explanation of this unpleasant fact it is said that the flora of the great Eastern continent is composed of the survivors of a struggle for existence more intense, prolonged, and complicated than can have raged in other parts of our earth. Forms which have emerged victorious from such a contest have naturally great odds in their favour when brought in contact with the flora of New Zealand, Australia, or even America. Very similar is the case with the fauna.

(To be concluded.)

Spectrum of Potassium.—M. H. Deslandres (*Comptes Rendus*) has determined the wave-lengths of the rays of the spectrum situated in the extreme red. The stronger is 766·30, and the fainter 769·63.

"SHOWERS OF BLOOD."

In a recent session of the Paris Academy of Sciences M. Daubrée read a letter from M. Delauney concerning an alleged shower of blood observed in Cochin China on December 13th last.

M. Thoraude, "phû" of the district of Tay-Ninh, writes:—"On December 13th last I was returning with my family to Tay-Ninh in a public conveyance, along with four native passengers and two children. About 4 p.m., whilst at a distance of five miles from Tay-Ninh, the conductor turning to me asked, in an angry tone, why I had scattered over his clothing blood from a cut in my fingers. Annoyed at this unfounded accusation, I looked at my hands, and saw, to my no small surprise, the fingers all stained with blood. At this sight I fancied that I must in reality have cut my fingers on some sharp object without being aware of it. But on wiping my hand with a handkerchief I saw that there was nothing of the kind.

I asked the other passengers if they knew how the blood had got upon my fingers, but they knew no more than myself. On examining my clothing and looking about, I found a considerable number of small spots, which, upon my black coat, appeared black, but upon touching them I saw, as did the other passengers, that they had the appearance of blood slightly curdled.

Some minutes after, one of the passengers, named Pham-thi-Lê, saw the face of her child besprinkled with drops of blood. It was the same with the white dress of my little boy, and with my umbrella, which had been placed behind the conductors. One of them, who was in front of us, perceived a prodigious number of blood-spots on his white jacket. The next morning when I wished to collect these blood-spots for examination I found that the garments had already been washed.

As for the trees at that point of the road where this phenomenon was observed, there were three so-called "ven-ven," two banyans, and one "cay-dal." Whilst the blood-drops fell, the sky was completely overcast. The passengers observed no rain, but they agree that the ground was moist."

A second letter from a native of rank, named Lânh, also announced a shower of blood which had fallen at the same time at Hiêp-Ninh, a place at no great distance.

M. Delauney added to these notes the announcement that he was about returning to France, and should bring with him the umbrella of M. Thoraude, to admit of an examination of the alleged blood spots. No similar phenomenon, it appears, had been previously observed in Cochin-China.

In Europe and Western Asia, however, the case is different. In the records of classical antiquity, in the chronicles of the dark ages, and in popular sagas down to the seventeenth century, rains of blood figure not unfrequently. Obsequens, in his work on "Prodigies," which was republished in 1555, speaks of several showers of blood which he had found described by ancient historians. At Saturnia it rained blood in the city for three days, so there was also a rain of blood on the murder of Tatius. Such phenomena were, of course, regarded as dreadful portents, and are said to have occasioned no little consternation.

But in what light are we to view them? Are these traditions simple, baseless falsehoods, or are they records of facts? There can be no hesitation in saying, neither

one nor the other. That drops of a red or reddish fluid did actually appear on walls, on roads, on trees, and possibly on the garments of the people need not—or rather cannot—be denied. But they were not blood. Their number would no doubt be grossly exaggerated, and all accompanying circumstances would be distorted by the fears of superstitious beholders. We must remember that from the time of Socrates down to the seventeenth century the people of Europe, irrespective of nationality, were, perhaps, the worst observers who have ever lived. They had been taught by the overrated Greek philosopher just mentioned and by his followers, heathen and Christian alike, to turn away their attention from nature and to concern themselves with words and abstractions. Hence, as regards simple matters of fact the evidence of an Arab or an American Indian is much more trustworthy than that of a mediæval Englishman, Frenchman, Italian, or German.

At the same meeting of the Academy of Sciences, when the letter of M. Delauney was communicated, M. Blanchard gave the following explanation of these alleged showers of bloods or of bloody water:—"Certain waters occasionally present a bright red colouration. On the coast of the Mediterranean the salt marshes are sometimes found quite red. In 1830 Payen ascribed this colouration to the presence of a small branchiopod crustacean, *Artemia salina*. Soon afterwards Dunal, of the Faculty of Sciences at Montpellier, showed that the red colour is due to a plant of the genus *Protococcus*, sometimes called *Hæmatococcus*. A species of this genus gives rise to the phenomenon of *red snow*, well known in arctic and Alpine regions. In 1840, Joly, of the Faculty of Sciences of Toulouse, in a memoir on the *Artemia*, confirmed the observations of Dunal, and proved that *Artemia* is red only when it has been feeding on *Protococcus*. Thus we may easily understand how a sudden gust of wind may scatter the reddened water upon the ground and the passers-by."

Without at all casting a doubt upon this explanation, we may admit that it is not the only possible solution of the question. It is well known that many lepidopterous insects—moths and butterflies—on emerging from the chrysalis, eject a drop or two of a red, orange, or reddish-brown liquid, which by a careless or a terrified observer might easily be mistaken for slightly coagulated blood. When these insects emerge simultaneously in vast numbers, the red drops are proportionately numerous. Any one who observed the vast swarm of *Plusia gamma* which crossed the Channel in August, 1878, and swarmed over the southern and midland counties, will readily believe that at the spot where these moths emerged, the red drops must have been numerous enough to pass for a shower.

M. Gaston Tissandier, commenting in *La Nature* on the Cochin-China incident, above-mentioned, states that in 1813 Professor Sementini communicated to the Academy of Sciences at Naples the result of his observations on a red rain which had fallen at Gérace (?) on March 14th of the same year. He found that it contained a red ferruginous powder of earthy origin, which had been swept up from the soil by the wind. In 1860 Signor Campini and Gabrielli examined a red rain which had fallen at Sienna from December 28th to the 31st, and found in it organisms analogous to those mentioned by M. Blanchard.

We need scarcely add that blood has never been recognised, optically or chemically, in any red rain.

Reviews.

Tenants of an Old Farm. Leaves from the Note-Book of a Naturalist. By Henry McCook, D.D. With an Introduction by Sir J. Lubbock, M.P., F.R.S., etc. Illustrated from Nature. London: Hodder and Stoughton.

The merits of Dr. McCook as an accurate and persevering observer of insects are well-known to all naturalists. His "Natural History of the Agricultural Ants of Texas" and his work on "The Honey and Occident Ants" have won for him a high and wide reputation. Under these circumstances the scientific public were gratified at learning that he had undertaken to furnish a number of essays on insect life, giving prominence to his specialities—ants and spiders. It was understood, as we find it intimated in the preface, that these essays should express the latest and best results of scientific research, and thus have a real scientific value and standing, "whilst at the same time—as could easily have been done—they were to be adapted to the taste and understanding of lay readers.

To our regret, this plan, under "the persuasion of friends," has been modified. The matter has been thrown into a colloquial form by the introduction of a number of characters who, to us at least, seem by no means interesting, and the valuable facts here to be found have to be sought for amidst a quantity of gossip having often but the slenderest connection with the subject.

Thus we find in the table of contents a chapter said to dwell on "A Battle, a Conquest, and a Night-Raid." We turn to it in the expectation of finding some light thrown upon the wars of ants. But behold, it is merely a description of a fight between two dogs, in which the "school-ma'am — Anglicè, schoolmistress — interposed and fared as it often happens to peace-makers. Here, then, we find six disappointing pages which would be entirely beside the question had not cobwebs been used to stanch the blood!

An interesting account of the harvest-ant of Texas is heralded by an eleven-page description, illustrated, of the "Blue Church," the services there and a feud between two parties among the Quakers.

But the genuine scientific matter in the book, if obscured by these irrelevancies, will bear seeking out. We learn, for the first time, that bumble-bees are particularly attracted by objects of a black colour. Boys, when destroying a bee's nest, a very reprehensible sport, as Dr. McCook points out, use as one of their weapons a black jug, half filled with water, into which the angry bees plunge. It seems also that they will, if disturbed, attack by preference any person dressed in black. This fact, which deserves studying, is the more curious as for many insects white objects seem exceptionally attractive. At least, we have often found abroad, that a double crop of insects may be gathered by laying down a white cloth in a woodland clearing, one lot upon the cloth and one underneath.

We find a venerable instinctarian converted to a belief in the rationality of the lower animals by learning that a turret-spider (*Tarentula arenicola*) had lined her nest with some cotton which had been used to prevent her from escaping during conveyance to a vivarium. She at first began to throw the cotton away, but discovered that it was capable of being utilised, and acted accordingly. This fact is one of Dr. McCook's many valuable observations. But the instinctarian in question does not see

that "the theory of evolution has any advantage over a theory of special creations." (Note the plural here used!)

The author's plea for the spider is well worth quoting and acting upon: "She is," he writes, "without reservation, a friend to our race, destroying noxious insects by myriads and making in return no impost or levy upon our orchards, vineyards, cupboards, and cellars." All this is perfectly true, and so long as Arachne contents herself with flies, gnats, cockroaches, earwigs, aphides, and the like, we should never blame her. But when the strong-minded lady ensnares honey-bees, rare and lovely butterflies or beetles, and especially small birds—for which we have the authority of Mr. Bates—we feel that she is going beyond her rights, and is justly open to our interference.

The cannibalism of spiders and others comes in for a notice suggesting to the author the reflection that among mankind "the big brothers eat the little brothers, and the monopolies swallow all." One of the interlocutors asks concerning the pupa of the Polyphemus moth, "how the caterpillar eats itself within this cocoon," adding, "I feel very much as the somewhat under-wise and stuttering King of England, George II., is said to have felt when he first saw an apple-dumpling." The speaker, though a "schoolma'am," is here astray: the monarch in question was George III.

In a subsequent part of the volume an additional sin is brought home to the skunk. This evil-smelling beast tears up the nests of bumble-bees, and devours the young brood.

A word as to the illustrations. Many of them are evidently direct from nature, and will prove very serviceable to the reader; but there are others, spoken of in the preface as "admirable comical adaptations," in which insects are represented in human attitudes, walking on their hind legs, wearing shoes, and committing other absurdities. At these the naturalist can afford to laugh. But how is the outsider, after reading on the title-page that the book is "illustrated from nature," to distinguish in these cuts the true from the false? We hope that the artist who designed these monstrosities will never again attempt to illustrate any work on natural history. In publications of the *Punch* class he may do good service.

The book certainly contains enough, and more than enough, original observations to make it valuable to working naturalists, and in that conviction we may recommend it. The reader will do well to turn to the index at the end, which refers to the scientific matter only, and to be guided by it in his studies.

First Annual Report of the Agricultural Adviser to the Lords of the Committee of Council for Agriculture. 1887. (*Insects and Fungi Injurious to the Crops of the Farm, the Orchard, and the Garden.*) London: Eyre and Spottiswoode. Price 3d.

It appears that the body which in this country acts as a substitute for a responsible Minister of Agriculture has selected an "Agricultural Adviser." Their choice has fallen upon a Mr. Charles Whitehead, of Barming House, Maidstone. Whether this gentleman possesses any special qualifications for the important duties which will devolve upon him we do not learn. We should think that an agricultural adviser should be a chemist, a botanist, and an entomologist, or at least one of the three. This, we think, is demonstrated by the fact that the present report has to deal with injurious insects and fungi.

The pests here noticed are the ribbon-footed corn-fly (*Chlorops tæniopus*), the corn saw-fly (*Cephus pygmæus*), the Hessian fly (*Cecidomyia destructor*), the clover eel-worm (*Tylenchus devastatrix*), and the hop-mildew (*Podosphæra castagnei*).

The author concludes, in accordance with general experience, that long winters and cold springs, with a prevalence of dry, chilling east winds, favour the spread of aphides and the caterpillars of the smaller moths. He considers the Hessian less destructive, as far as the past season is concerned, than the *Chlorops* and the *Cephus*. The Hessian fly seems to have reached this country from Russia, where it has only been known for about eight years. It is accompanied, fortunately, by the parasites which prey upon it in Russia, but not by its American enemies.

Much of the information in this report is due to Miss E. Ormerod, F.E.S., Consulting Entomologist to the Royal Agricultural Society.

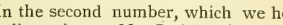
Transactions of the Institution of Engineers and Shipbuilders in Scotland. Thirty-first Session. 1887-88.

The papers in this issue treat of the "Erection of the Superstructure of the Forth Bridge," the "Stability of Yachts," and on "Liquid Fuel." In the last memoir the author, Mr. James M. Storrar, quotes from Admiral Selwyn the information that there exists in this country more oil-producing shale than all the coal which has yet been found. There are beds of shale stretching right across England, from 650 ft. to 1,100 ft. in thickness, and lying close to the surface. Different samples of this shale have been analysed at various times by eminent chemists, and the yield of oil has varied from 50 to 120 gallons per ton, which would give a supply practically inexhaustible. The author's conclusions are that, except in exceptional circumstances, such as proximity to oil supply or remoteness from coal supply, it is not likely to become advantageous in case of land boilers. For marine boilers it may, or ought to be, cheaper than coal, if we take into account the saving in stowage room and in stoking.

Journal of the Society of Telegraph Engineers and Electricians. Vol. xvi., No. 69, and Vol. xvii., No. 70.

We have here a discussion on some papers read before the Society on November 24th last, on Fleming and Gimingham's instruments for measuring electro-motive force and electrical power, and on Ayrton and Perry's portable volt-meters for measuring alternating potential differences. Next follow the proceedings at the annual general meeting on December 8th last, and a paper by A. C. Cockburn, F.C.S., on safety fuses for electric light circuits. The author finds pure tin preferable to any other metal or alloy for safety fuses. It melts at 235° C., at which temperature it is unable to char wood, and drops its weight, when the circuit is broken and the current cut off.

In the second number, which we here notice, follows the discussion on Mr. Cockburn's paper.



Climatological Encyclopædia.—Dr. Cruls, director of the observatory of Rio de Janeiro, is preparing a universal climatological dictionary. The enterprise is under the patronage of the Emperor of Brazil.

THE FORMATION AND FUNCTIONS OF STOMATES.—II.

(*Concluded from page* 309.)

BEHIND the stomal orifice there always exists, in the tissue of the leaf, a hollow space several times larger than the stoma, known as a respiratory cavity; by means of this space the work of transpiration or evaporation of water is greatly facilitated. Into these spaces vapour from the water in the surrounding tissue of the leaf is given off, and passes out at the stoma when open, dry air diffusing in to take its place. There the influence of sunlight again comes into play, the accompanying heat first increasing the watery vapour, then causing, by expansion, its more vigorous expulsion from the respiratory cavity. But as the internal tissue of the leaf loses water, it draws a fresh supply in the form of sap from the veins, which consist of very fine tubes and woody fibres, and these in turn by their connection with similar tubes in the leaf-stalks, branches, stem and roots, draw up water impregnated with inorganic salts from the soil.

Transpiration or the elimination of water, however, though the chief, is not the only, function of the Stomates. It has been mentioned how the sunlight, by its influence on the grains of chlorophyll, or green matter in the guard-cells, brings about the formation of starch out of the carbonic acid gas in the air and the water in the leaf—starch being composed of carbon, hydrogen, and oxygen. But this process, though a useful one to the guard-cells, produces too small an amount of starch to be of any importance in the general nutrition of the plant. It is in the mass of chloropyll-bearing cells which underlies the transparent epidermis, and gives to the foliage of plants its refreshing and characteristic colour, that the general supply of starch is produced. But before starch can be made it is necessary that carbonic acid gas enter the leaf, and come into contact with the green cells. And here again the advantage of the stomal communication comes into requisition, for although carbonic acid, being a gas, can penetrate the thin membrane of the epidermis, it cannot do so as rapidly as through the open stomates. The carbonic acid gas, upon contact with the green-cells, is split up into its two component elements, carbon and oxygen, the carbon being retained and the oxygen being given off at the open stomate. This is the process which renders the presence of trees in moderate numbers so healthful in thickly-populated districts. It is not, however, as it is sometimes so misunderstood, a process of *respiration* but of *assimilation*. Consider then on a summer's morning what a wonderful amount of silent activity is gradually set in motion in the plant world by the breaking forth of sunlight upon the earth. In the trees, with their milions of stomates (the lilac leaf has 160,000 per square inch of under-surface), the watery vapour locked up in the respiratory cavities passes out between the dilating guard-cells into the air; the sap slowly moves upwards to supply the fresh demand for vapour, bringing with it earth-salts from the soil to the leaf-laboratories, there to be compounded into plant food with the starch which is being formed out of the incoming carbonic acid gas, whilst oxygen passes out into the air to carry on the respiration necessary to all life whether animal or vegetable.

Transpiration being the chief work of the Stomates, it may not be uninteresting to consider some of the ways in which it affects plants, and how it in turn is affected by internal and external influences. Such considerations must, however, be limited to land-plants, as stomates are seldom present on submerged water-plants, and only those land-plants which exhibit a distinction into leaf and stem. Colourless parasitical plants also may be excluded; an instance of the scarcity of stomates on these is seen in the mistletoe, which possesses only 200 to the square inch, a very insignificant number compared with that in the lilac, cited above. To only such land-plants then as are not lower than the mosses and liverworts, and are not parasites destitute of chlorophyll, will the following remarks apply.

The existence of transpiration may be easily proved. When a plant is plucked and left in the sunlight it withers through loss of moisture, and this loss may be tested by comparing the weight of the plant at the time of plucking, and some hours afterwards. This is the reason why plants so quickly become flaccid and lifeless when taken from the soil, and not, as it is sometimes imagined, from want of food. This also is the reason why leaves and stems droop in strong sunlight, and freshen at sundown; the waning of the sun's heat and light renewing the swelling of their cells. The greater part of this evaporation must take place through the stomates, as the skin of plants is specially formed to resist the passage of aqueous vapour. Again, those who keep ferns under shades know how bedewed with moisture the inside of the glass covering becomes, and the amount of water thus transpired may be readily ascertained by putting a quantity of dry chloride of lime or concentrated sulphuric acid into an open dish, and then placing it under the shade with the fern. These substances absorb moisture very readily, and the difference between their weight when put under the shade, and when taken out, will give about the weight of water transpired during the time. To make the experiment more conclusive a pot of earth, subject to equal conditions of dampness and sunlight, may be tested in a similar manner. The quantity of water thus given off by plants is something considerable, and may be appreciated from the following details:—A healthy tobacco plant, or a sunflower the height of a man, will transpire from a pint and a half to a quart on a summer's day, and full-grown oaks, poplars, and other large trees from eleven to twenty-two gallons daily, and Hohnel has computed that a patch of a little over two acres of beech forest a hundred and fifteen years old yields about 500,000 to 700,000 gallons from June 1st to December 1st. Great humidity is thus produced in densely-wooded districts, and the effects of transpiration meteorologically is such that the gradual removal of a large tract of forest has considerably decreased the rainfall in the neighbourhood. It is for this reason that the presence of large quantities of trees is apt to render the atmosphere of a place so damp as to be unhealthy, whilst on the other hand the great scarcity of trees produces the same effect through too much dryness, and the non-absorption of carbonic acid gas; it is in the medium that salubrity lies.

(*To be continued.*)

THE COLD SEASON.—According to the *Popular Science Monthly*, recent winters in Iowa have been more severe than earlier ones. In January last the thermometer was at or below 0° F., every night from the 11th to the 20th.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY OF EDINBURGH.

At the meeting held on the 2nd April a study on the conjugated sulphates of the copper-magnesium group by Prafulla Chandra Ray was read. It dealt with the getting of successive crops of crystals from nearly saturated liquors, and comparisons were given of the different compositions of the several crops of crystals.

Mr. A. Dickie, Glasgow, communicated through Dr. John Murray some remarks on the chemical analysis of water from the Clyde sea area. Dr. Murray said it would be remembered that Professor Dittmar, in his extensive memoir on the *Challenger* observations, gave a large number of analyses of the oceanic waters. But these specimens had been chiefly collected in the open sea at the surface, at intermediate depths, and at the bottom. The results obtained were very interesting, but for purposes of comparison it had been found that it would be exceedingly valuable to have a series of similar analyses taken from places where the ocean waters were considerably modified by the waters flowing from the land. The *Challenger* analyses had shown that not only were the ocean waters far away from land characterised by a definite chemical composition, but there was a great uniformity in the kinds of life found in other circumstances. The *Challenger* observers had also found that when they came into estuaries, and examined the animals that lived there, both in the subsurface waters and at the bottom, the forms of life changed very considerably, and that the biological character of the waters was considerably different from that of the open ocean. A Government grant having been obtained for investigation of the composition of the shore waters, specimens of the water for analysis were collected in the Clyde sea area, and Mr. Dickie, of Glasgow, undertook to make the analysis under the superintendence of Professor Dittmar. Mr. Dickie found, starting from the Mull of Kintyre and proceeding up into Loch Fyne, Loch Long, and Loch Goil, that the bottom waters progressively were salter than the surface waters. Mr. Dickie left the discussion of the general result to others more acquainted with the details of oceanography. But the great point was that the results gave the data for a more extensive comparison when any other investigators chose to make use of them, and no doubt this would be done before long. Mr. Dickie had not yet completed the investigations committed to him by the Society. He was now residing at the Clyde, and trying to determine the amount of carbonic acid in the water, and the committee of the Society hoped to have a further communication from him on the subject.

A letter from Professor His, of Leipzig, on the principles of animal morphology was read. Professor His gave details of observations he had made on the development of the germ and the embryo, and of the heart, the neck, and the nerves in the higher animals. He made sections through the heart in its young developing condition, studied these, and pieced them together again. The total value of a body, he maintained, was found by adding together all the partial values. There might be great developmental changes without increase of bulk, and he gave examples of such. The general scientific methods of measuring, weighing, and determining volume must not be neglected in embryology. That science and morphology could not proceed independently of all reference to the general laws of matter. The various organs of the body were formed by the folding of layers in the germ, and the study of these layers was therefore of the greatest importance. He condemned dogmatism in scientific teaching, and also the practice of explaining all the characteristics of form in animals by heredity alone. He did not undervalue heredity, but the principle could not keep science from inquiring into the mechanical formation of organisms. Direct explanation could only come from studying the phases of individual development. Every stage must be looked at as the physiological consequences of a preceding stage. He again pressed forward the importance of elementary mechanical considerations in treating morphological questions.

Professor Tait contributed some mathematical notes.

ROYAL GEOGRAPHICAL SOCIETY.

At the meeting on March 26th, Mr. C. M. Woodford read a paper, entitled "A Naturalist's Explorations in the Solomon Islands." These islands are a group lying about 500 miles to the eastward of New Guinea, and extend for 600 miles in a north-west and south-east direction. The total land area Mr. Woodford estimated at 15,000 square miles. The islands are for the most part clothed from the coast to the mountain tops with the densest tropical forest, in which the immense ficus trees of several species are often conspicuous objects; their trunks covered with creepers and ferns, the undergrowth consisting of small palms, among which, and over the trees, the immensely long rattans or climbing canes twine in and out in inextricable confusion. The produce of the islands is chiefly cocoanut, the sago nut (used for making vegetable ivory buttons, etc.), and pearl and turtle shell.

GEOLOGICAL SOCIETY OF LONDON.

On March 28th, W. T. Blanford, LL.D., F.R.S., President, in the chair, the following communications were read :—

1. On some Eroded Agate Pebbles from the Soudan. By Prof. V. Ball, M.A.

The majority of the pebbles in a collection made by Surgeon-Major Greene in the Soudan, and presented by him to the Science and Art Museum in Dublin, are of very similar character to the agate and jasper pebbles derived from the basalts of India. It may be concluded inferentially that they came originally from a region in which basaltic rocks occur to a considerable extent. A certain number of them are eroded in a manner unlike anything noticed in India, though it is probable that similar eroded pebbles will eventually be found there.

Throughout India, wherever there is deficient subsoil-drainage or excessive evaporation and limited rainfall, salts are apparent either in supersaturated subsoil-solutions or as crystallisations in the soil. They are most abundant in basaltic regions, and in a lake occupying a hollow in the basalt in Berar carbonate of soda is deposited in abundance from the water, which becomes supersaturated during the summer.

The author commented on the efficacy of such a liquid as a solvent of silica, and noticed the selective action of the agent which had affected the Soudan pebbles and had corroded some layers more than others; he sug-

gested that while this might be to some extent due to differences in composition, it was more probably owing to differences of nodular constitution. He considered it unnecessary to refer to the action of humic acid, because, while the salt to which the solvent action is attributed would be capable of doing such work, and would be probably abundant in the region referred to, we could not expect any great amount of humic acid in the same area.

On the Probable Mode of Transport of the Fragments of Granite and other Rocks which are found imbedded in the Carboniferous Limestone of the neighbourhood of Dublin. By Prof. V. Ball.

Angular fragments of granite and of schist, quartzite, and vein-quartz, such as might have been derived from the metamorphosed rocks which rest on the granite near Dublin, have been discovered in beds of carboniferous limestone, which often contain fragments of fossils, especially Encrinites. They have been previously noticed by Professor Haughton, Mr. H. B. S. Montgomery, Prof. Jukes, and Mr. Croll. While Prof. Jukes refers their transportation to the agency of land-plants, Mr. Croll quotes their occurrence in support of his argument as to the existence of glacial conditions during the carboniferous period.

The author observed that the specimens exhibited none of the indications of the existence of glacial conditions, whether we regard the characters of the boulders or the nature of the rock in which they are imbedded, which contains no such silt as that occurring in the boulder-bed of the Talchir formation. Whilst rejecting the view that they were transported by ice, he pointed out that they need not necessarily have been carried by land-plants, but that they might have been torn from the sea-floor by marine algæ, some of which may have had a more buoyant character than those of modern seas. He cited the case of a sandy beach in the neighbourhood of Youghal, which is strewn with limestone fragments, which had been conveyed by sea-weeds thrown up after storms from submarine banks.

It was suggested that the occurrence of natural fissures in the rocks and cracks produced by concussions from large masses hurled about by the waves might sufficiently explain how the fragments could be freed from the main mass of the reefs under the stress of the waves.

The Upper Eocene, comprising the Barton and Upper Bagshot Formations. By J. Starkie Gardner, Esq., F.G.S., and Henry Keeping, Esq., with an Appendix by H. W. Monckton, Esq., F.G.S.

The familiar Upper Eocene having been transferred to the Oligocene, the remaining uppermost division of the Eocene bears the title Middle. Unless the considerable literature relating to the Brackleshams, the Calcaire Grossier, and the Nummulitic is to be rendered obsolete, their classification as Middle Eocene must be preserved, and a modified Upper Eocene constructed out of the Barton series.

The base of the formation is not sharply defined, but it coincides with the final disappearance of several subtropical Mollusca, and almost with the extinction of Nummulites in our area. The upper limit is drawn at the base of the Lower Headon, where the brackish fauna gives place to one of fresh water.

The conditions of deposition were examined at some length, and evidence in support of the estuarine origin of the formation was adduced. The fauna of the Lower Barton division comprises many Bracklesham species, which range no farther up, and a large number of peculiar species. The most convenient base-line for the Middle Barton is the lowest of several bands of Septaria, which distinguish the 50 feet of drab clays which are comprised in it. The finest Barton fossils are obtained from the Middle division; but though so many splendid species characterise it, few are absolutely confined to it. The upward range of a further number of Bracklesham species ceases at the shell-bed. The Upper Barton includes the *Chama*-bed, the Becton Bunny, and the Long Mead End beds.

Mr. Monckton, in his Appendix, stated that in the London basin the Barton beds are represented by the Upper Bagshot Sand, a mass of yellow or nearly white sand without clay-beds, though often loamy. Its greatest proved thickness is 228½ feet, and the base is marked by a very persistent bed of pebbles.

Its extent is considerably greater than is shown on the Geological Survey map.

Casts and impressions of shells are abundant in some places, but recognisable species have only been found at Tunnel Hill, near North Camp Station, Aldershot. A large collection from this place has been made by Mr. Herries and by the author.

SOUTH LONDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

At the February meeting of this club, Dr. M. C. Cooke read a paper on "Horny House Builders; or, Zoophytes."

The author said an enthusiastic naturalist had published an interesting record of his rambles, including trips by boat off the Sicilian coast, where, in an absolute calm, with the surface of the water as smooth as a mirror, the eye was permitted to observe in detail the various forms of marine life at an almost incredible depth. Among the things to be seen were little shrub-like structures, every bud and spur of which was an animal. Few had been privileged to see these plant-animals flourishing in their native seas, but all had been made acquainted with their skeletons, or, more happily, their deserted houses, when, torn from the rocks by storms, they were cast upon the beach. It was hardly surprising that in days gone by these organisms—by some incorrectly called corallines—should be regarded as sea-plants or weeds, and when their minute structure and method of life were unknown, it was quite excusable that such mysterious "toilers of the sea" should be deemed vegetable in nature. Now, however, when their inmost secrets had been revealed, no one would hesitate to pronounce them animals. That portion of the colony which was permanent was the branched horny tubes. The little animals were contained within these branches, and soon died when removed from their native element. The material of which the sheath was formed was called "chitine"—a substance that differed from horn in its chemical composition. There were many forms of these animals. Some preferred shallow, others deep water; some attached themselves to the rocks or the larger sea-weeds; and, again, some of the smaller were parasitic on the larger species. The animals resembled fresh water hydræ, united together into branched colonies of some hundreds of individuals, and located, like the lodgers in a model lodging-house, within one common home. It was a beautiful sight to see one of these branched colonies

with all its inhabitants in full activity. At the least alarm the tentacles and partly-protruded body were withdrawn into the opening of the polype, and a minute trap-door closed over them to protect them from injury, each opening being furnished with a tiny operculum, or lid, that was pushed up when the animal protruded itself, and fell back when it retired. As few survived on being transferred to an aquarium, many attempts had been made to kill the animals suddenly when expanded, so as to mount them as permanent objects for the microscope. The theory was that if, whilst expanded in sea water, fresh water was suddenly ejected on them they would be killed before they could retreat; but it was not so easy to put the theory into practice, and failure was far more common than success. With reference to the structure of these animals, the fixed polypes attached to the common body took in the nutriment for its support. Each consisted of a sac with an internal mouth, surrounded by tentacles. From the mouth the hollow cavity continued below into a common channel, traversing all the branches and the main trunk. The tentacles were thread-like appendages, containing the only organs of offence and defence these little creatures possessed. When food was conveyed into the mouth, and digested, it passed into the canal, which traversed the whole colony. The walls of the canal were lined with vibratile cilia, which kept up a continuous current, and thus every part of the structure was supplied with all that was necessary to maintain the vigour of the community. The individual polypes often became absorbed, and in some species there appeared to be a sort of winter rest, but with the return of spring the polypes were produced as plentifully as ever. The fixed or permanent polypes were neuter in sex, and corresponded to the workers in a beehive. For the multiplication of the species, special buds were set apart, being produced only at certain seasons, and occupying different positions in different species. The buds consisted of an outer protective covering, enclosing either a male or female zooid, and these, becoming free, entered upon an independent existence, and presented such a contrast to the original stock, both in shape and habits of life, that it seemed difficult to believe the new animal had any relation to the old. In most cases it assumed the form known to marine zoologists as that of the medusa—a small crystal dome, so delicate that it could only just be distinguished in the water, through which it was propelled by the contraction of its side, and with a fringe of long tentacles that waved and floated like threads in the liquid element. It would be difficult to exaggerate the beauty of these floating flower-like bubbles, with their vivid tints and graceful outline. To their other charms, that of phosphorescence was often added, and though individually minute, their numbers were so immense that they played an important part in the luminosity of the ocean. Increase by means of budding, so general in the colony, was by no means absent from the free swimming polypes. It was not unusual when the true reproductive function was arrested or in abeyance for buds to be produced on the structure, most commonly on the lower margin of the swimming bell, and those buds originated free zooids in all respects like the parent from which they sprang. Typically the free swimming polypes were either male or female; but it must not be assumed that all the species produced free swimming polypes, some being fixed. The embryos, which now for a short time led a roving existence, had their outer surface covered with vibratile cilia. After a time the body enlarged at one end, and a thin, horny film was formed over a portion of the surface; its movements slackened, and at length ceased; the cilia disappeared, and the embryo became attached to the rock by the enlarged end, which flattened out into a disc. This was the first step towards the foundation of a new colony. In the course of time the upper end developed into a fixed polype, enclosed within a capsule with a movable lid, and by a series of successive buddings and branchings a plant-like colony was built up in all respects resembling the original parent. Growth was comparatively rapid for the size of the little animal concerned in building it—a large specimen of one kind of sertularia being under favourable circumstances formed in the course of fourteen days.

ZOOLOGICAL SOCIETY.

At the monthly general meeting, held on March 22nd, at the Society's house, in Hanover Square, Dr. E. Hamilton (Vice-President) in the chair, it was stated that amongst the additions to the Society's menagerie during the month of February was a second specimen of Griffith's fox (*Canis Griffithsii*), from Bussorah, received on deposit; four small and very beautiful finches (*Erythrura psittacea*), obtained by purchase; and five pheasants (*Phosianus principalis*), presented by Major Peacock, R.E., of the Afghan Frontier Commission.

ROYAL HORTICULTURAL SOCIETY.

At the last meeting of the Scientific Committee, Dr. Masters reported that the blue daisy exhibited from Tangier at a previous meeting by Dr. Lowe was *Bellis annua*. Sir Joseph Hooker mentioned that it was common in the neighbourhood of Tangier, and that it was different from the plant found on the Atlas Mountain (*Bellis cærulescens*).

Dr. Masters, alluding to the great differences that exist in the species of Pinus as to the time at which the constituent scales of the cone separate in order to liberate the seed, showed a series of cones of *Pinus insignis*, the oldest of which bore the date 1864. In this all the scales were widely separate. The most recent cones dated from 1877, and in them the scales were not at all separated. Between these two extremes, cones were shown exhibiting almost every intermediate stage of separation. It is to be remarked that the separation begins generally just above the centre of the pendulous cone on the side furthest away from the branch, at the place where the obliquity of the cone, due to the free exposure to light and air, and the absence of obstacles afforded by the branch was greatest, and that it follows a spiral course towards the base of the cone. The scales separate in successive spiral coils, till, at length, all except a few at the base and apex respectively, and which are probably sterile, are separated one from the other.

Dr. Masters also referred to various semi-double and other orchids submitted to him for examination.

Dr. Masters exhibited a drawing of a magnificent new Anthurium, *A. Chamberlaini*, which had appeared accidentally with an importation of Cattleya Gaskelliana, in the garden of the Right Hon. J. Chamberlain. The heart-shaped leaves are of gigantic size, and the large boat-shaped spathe is of the richest crimson colour.

Mr. T. Christy sent some seeds of *Euchresta Horsfieldii*

which in appearance are not unlike roasted coffee. The natives of Java use them as a tonic and to arrest the spitting of blood. The shrub is the only known species, and grows in the mountain districts of Java and Formosa. Dr. Horsfield says the natives use the seeds as an antidote to any poison, and Leschenault says the powdered fruits mixed with food prevents diseases. Mixed with lemon-juice, they are also applied externally to wounds.

Mr. Christy also sent samples of chocolate made from the seeds of *Cola acuminata*,* and which he had ascertained to be useful in certain forms of indigestion.

MODERN PHOTOGRAPHIC ENGRAVING AND PRINTING.—II.

A Paper by Mr. George S. Waterlow, read at the Conference of the Camera Club.

(Continued from page 326.)

There are many details which are necessary to successful etching, but those now given will be sufficient to convey to you generally the method of making the zinc plate for the typographic block. After etching, there only remains the trimming of the zinc, a little touching up, and mounting it on a block of mahogany of exact thickness to render it type-high, and it is now ready for insertion with type in the printer's forme.

From a properly-etched plate, hundreds of thousands of prints may be obtained, or it may be electrotyped or stereotyped and multiplied indefinitely.

The next process on my list is engraving on copper in intaglio. There are many names now in vogue for this beautiful process, but it is best known by that of "Photogravure." The difference between an intaglio and relief engraving is implied by their names. In the one we are now to deal with the lines or ink-carrying parts of the plate, are sunk below the surface, instead of being highest, as in the case of relief or type blocks.

The great advantage of this process in point of beauty over that of zinc surface blocks is, that we are able to reproduce a drawing which is made with washes instead of lines, a painting, or a photographic portrait or landscape; but for commercial and general purposes it is not so useful as type-blocks, because of the expense and slowness of the printing. The ink has to be rubbed into the lines and hollows of the plate, and the surface perfectly cleaned for every impression.

There are many methods of producing these plates by the aid of photography, but details of most of them are either unpublished or are worked as secret processes. I shall, however, be able to indicate the method to you in general terms.

Instead of a negative, a positive on glass is required for the first operation. This positive must contain every gradation of tone in the original, and be as nearly perfect as possible. Next, a solution of gelatine, sensitised with bichromate of potash, and containing a graining matter, is thickly spread over a glass plate and dried; when dry it is stripped from the glass and placed with the glass positive in a printing-frame and strongly printed. After printing, the film of gelatine is attached to a metal plate, and developed with water like a carbon print; when sufficiently developed, the film is allowed to dry; on examination it will be found that the picture appears in the form of little elevations and depressions over the surface, the blacks being the highest and the whites almost bare metal, each gradation of tone in the positive being a different elevation in the gelatine. This film may now be brushed over with powdered graphite and placed in the electrotyping bath, and a printing copper-plate produced.

Another method is to sensitise the surface of the copper itself with the same grained bichromatised gelatine, expose it under a positive, and bite through with "perchloride of iron;" the etching fluid passes through the parts protected from light by the positive, and etches the copper in exact proportion to the solubility or insolubility of the exposed gelatine surface. This is the simplest of the many processes, and it answers well for a small number of printings, but it is not deep or strong enough for much hard work.

I now pass to a different photo-mechanical printing—*i.e.*, Woodbury printing.

This ingenious process is, like the others, founded on the peculiar oxidising action of gelatine in the presence of bichromate of potash; the process has now been before the world so long that most of you will be familiar, if not with the actual process, at least with its production. Great credit is due to the originator of this admirable process, and for the complete and practical issue to which he brought it.

Gelatine with bichromate of potash is spread upon levelled plates of glass, dried, and stripped; the film thus obtained is exposed to light under an ordinary negative; the film is then cemented, face down on glass, and washed for several hours with hot water. After being allowed to dry, the film is again stripped from its support, and presents the appearance of a delicate piece of silk, with an exquisitely-modelled picture in fine relief. Its texture, delicate and fragile as it may appear, possesses extraordinary strength, and in the next operation is subjected to a pressure of hundreds of tons in contact with the hardest steel, and comes out of the ordeal unharmed, and ready to be used again and again without injury. The printing-plate or block is made of hard, rolled lead, and is placed face down on this gelatine film or relief on a steel block in a powerful hydraulic press, where it receives immense pressure—often that of 500 tons. The raised image on the gelatine is thus forced into the lead plate or block, and gives a mould ready for the special printing it is to receive.

The printing is rather difficult to explain. The lead mould is laid on a plastic cushion on the bed of a small press, and its face brought up almost level, but not quite, with a sheet of plate-glass cemented to an iron lid (or platen) hinged on the top of the press; the hinged lid is lifted by the printer, and he pours on the mould warm ink made of gelatine and colouring matter. A sheet of prepared water-proofed paper is laid on the pool of ink, and the lid shut down and clipped by a lever motion; this spreads out the gelatine ink over the entire mould, squeegees it away from the highest parts, or whites, and leaves it only in the hollows, or dark and toned parts of the picture. In a few minutes the warm layer of ink cools and sets, and on the press being opened, the sheet of paper with the ink from the mould adhering to it is carefully removed. This is the Woodbury print, and now only requires drying and fixing in alum to make it the finished permanent photograph which is so familiar to all.

* See page 157

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

AERIAL MACHINE. — Mr. S. Lemmon, Union-street, Portsea, has patented an aerial machine. In this invention balloons proportioned to sustain the machine and rider above natural obstacles are attached to two angular frames, the front frame of which can be inclined by cords and a windlass. The machine is propelled by the rider seated on a seat, operating paddle-wheels on a shaft, through treadles, connecting rods, cranks, and cord-pulleys. Steering is effected by turning a handle connected by gearing to a rudder or to a clutch-box for rendering one paddle inoperative.

A LAMP EXTINGUISHER.—Mr. F. R. Baker, of Snow Hill, Birmingham has patented a lamp extinguisher. The object of this invention is to automatically extinguish hydrocarbon and other oil lamps, and is effected by means of a ring of metal sliding down an incline, and carrying forward an extinguishing shutter-case, having single or double shutters, upon which are projections. These projections, as the shutter case advances, come in contact with the interior of the cone, and close the shutters together, thus extinguishing when overturned. To operate the mechanism by hand, an arm is provided, standing out from the sliding shutter-case to the outside of the lamp, accessible to the hand.

BOOT SOLES.—Messrs. J. Thornhill, and T. Gallimore, Gainsborough, have patented an improvement in the manufacture of soles for boots, with a view of making them very durable for this purpose. Holes, preferably of an elliptical shape, are cut through the sole of the boot at the parts where the greatest amount of wear takes place; in these holes are inserted, from the flesh side of the sole, pieces of suitable metal, provided with points which enter the leather and secure the protectors in position, the other surface of the protectors coming flush with the wearing side of the sole. Each protector is cast in sections, which allow of their being easily inserted, and of the sole bending freely to the movement of the foot of the wearer.

ATMOSPHERIC BREAK.—A pneumatic railway brake has been patented by J. Y. Johnson on behalf of L. Soulerin, Paris. The invention relates to apparatus for working railway brakes by means of compressed air or vacuum, combined in some cases with electrical appliances for operating the valves. When compressed air is to be used, an automatic air-pump, worked by steam from the boiler, keeps up a constant pressure in a main reservoir, from which the air passes through a driver's valve of special construction to the train pipe, and thence through distributing valves, also of special construction, to the auxiliary reservoirs and brake cylinders. The driver's valve is a spring-reducing valve, by which the driver can regulate the pressure of the air in train pipe, and it has attached to it a slide valve controlling an opening to the atmosphere, by which the train pipe can be opened to the outside air for reducing the pressure in applying the brakes.

DEFLECTOMETER. — Mr. O. Leuner, Dresden, has patented a deflectometer. The apparatus is intended to show the deflection of bridges when loaded. It is fixed to the bridge by set-screws, and one of two stepped pulleys, carried in centres on the frame, is connected by a steel ribbon and stout wire to a fixed point, such as a weight at the bottom of the river below. The largest pulley is connected by a steel ribbon with a spring barrel; carries a pencil for tracing on a drum covered with paper, and revolved by hand by means of a worm and worm wheel. The action is as follows:—Before the load is on the bridge, the ribbon is made quite tight, and the spring barrel wound up; the pencil is then set at the extreme left of the ribbon. When the bridge gives to the load, the ribbon slackens; but the slack is immediately taken up by the spring barrel, and the pencil moved to the right; the drum is meanwhile turned by hand, so as to obtain a diagram.

STOVE. — Mr. D. Cowan, of Mount Gerald, Larbert, N.B., has patented a stove. The invention relates to stoves from which the smoke and products of combustion are led away by a pipe. In carrying out this invention, instead of making stoves of two or more different patterns as regards the arrangement for the attachment of the smoke-pipe, each stove is made so that the smoke-pipe may be attached to it, either vertically or horizontally. The smoke-flue is arranged inside of the stove, so as to communicate with two openings, one in the top and the other in the back of the outer casing of the stove. These two openings are of exactly the same size, and a single closing plate is provided for closing whichever of the two openings the smoke-pipe is not fitted to. The closing plate is by preference made so as, when in position, to be flush with the outside of the stove, and is fitted with a bayonet joint so that it is secured by turning it partly round after placing it in the opening.

CONTACT BREAKER.—An arrangement for making and breaking an electrical circuit has been patented by Mr. F. P. Schmidt, of Hustlergate, Bradford. The object of the invention is the automatic breaking and closing of an electric circuit. The apparatus is secured inside a box, and consists of a series of wheels mounted in suitable framework: round one of the axles and secured to a wheel thereon is a coiled spring, and on the axle is fixed a lever. The spring is coiled up tight, and when the before-mentioned lever is operated, the spring is coiled tighter, thus setting the wheels in operation. On one of the shafts is a disc having a number of pegs inserted, which project therefrom; as the disc rotates, the pegs come in contact with an arm attached to a lever forming part of the electric circuit, thereby breaking the circuit as often as there are pegs in the disc, thus indicating at the central station the number of breakages, by which the attendant knows the district from whence the alarm has been sent.

FATTY MATTER IN MILK.—Some experiments conducted at the New York Agricultural Station have proved that the fats of butter are not derived directly from the fatty matter of the food, but are elaborated in the body of the cow.

ANNOUNCEMENTS.

GUY'S HOSPITAL MEDICAL SCHOOL.—The Michael Harris prize in anatomy, value £10, has been awarded to Mr. J. H. Bryant, of Ilminster; the Beany prize in pathology, value 30 guineas, to Mr. E. H. Starling, of Bombay; and the Golding Bird prize for diagnosis, value 33 guineas, to Mr. R. D. Mothersole, of Colchester.

HORTICULTURAL EXHIBITION AT COLOGNE.—Information has been received at the Foreign Office from the German Ambassador in London that it is proposed to hold at Cologne next August, on the occasion of the 25th anniversary of the foundation of the Horticultural Society "Flora," an International Horticultural Exhibition, under the patronage of Her Majesty the Empress Augusta. The Royal Horticultural Society have consented to act as a committee on behalf of any British horticulturists or others who may desire to take part in the Exhibition.

DANISH EXHIBITION IN LONDON.—An Anglo-Danish Exhibition and *Fête* will be held during the summer months at South Kensington under the direct patronage of the Prince and Princess of Wales, and of the Crown Prince and Princess of Denmark, in aid of the rebuilding of the British Home for Incurables at Clapham. All communications, except those relating to space in the arcades and quadrants, to be addressed to E. Ironside Bax, Secretary, Anglo-Danish Exhibition and Fete, South Kensington, S.W. Applications for space must be made on the official forms obtainable at the Exhibition offices, South Kensington, from Joseph Davis, the Manager for this department.

THE MELBOURNE CENTENNIAL EXHIBITION.—The Royal Commission for the Melbourne Centennial Exhibition are engaged in forming a loan collection of works of art, and the works already placed at their disposal for exhibition at Melbourne, though not yet very numerous, are of remarkable quality. Contributions are promised from the collections of the Queen, the Prince of Wales, the Duke of Westminster, Lord Rosebery, Lord Brassey, Sir T. Bazley, Sir Charles Tennant, Messrs. T. Agnew and Sons, Mr. W. Agnew, Mr. Gillilan, Mr. Abraham Haworth, Major Shuttleworth, Mr. Gregory, and other collectors, and the commission have every hope of obtaining a collection which will be representative of the best modern British art and worthy of so remarkable an occasion as the centenary of the settlement of Australia. They will be glad to receive offers of further contributions at their office, No, 69, Spring Gardens, up to the end of this month.

VICTORIA UNIVERSITY.—The Yorkshire College having been affiliated as one of the colleges of the Victoria University, a resolution confirming the affiliation was carried on March 28th, at a special meeting of the governors of the college at Leeds. Mr. F. S. Powell, M.P., presided, in the absence of Lord Ripon, and said he had taken the deepest interest in the college for many years. Its growth had been to him a source of great pride. He recently had the honour, with Mr. Bryce and other gentlemen, to introduce a Bill into Parliament, giving power to the Victoria University to hold property in mortmain up to a certain amount, which might be of considerable service, and also of giving the University privileges possessed by other such bodies to the effect that where the graduates of other Universities were eligible for any appointment the same eligibility should be held to extend to the graduates of the Victoria University.

INSTITUTION OF MECHANICAL ENGINEERS.—The ordinary general meeting will be held on Thursday evening, the 3rd of May, and Friday afternoon, the 4th of May, at 25, Great George Street, Westminster, by kind permission of the Council of the Institution of Civil Engineers. The chair will be taken by the President, Edward H. Carbutt, Esq., at half-past seven p.m. on Thursday evening, and at half-past two p.m. on Friday afternoon.

The following papers will be read and discussed, as far as time permits:—Third Report of the Research Committee on Friction: Experiments on the Friction of a Collar Bearing. Description of the Emery Testing Machine; by Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A. Supplementary Paper on the use of Petroleum Refuse as Fuel in Locomotive Engines; by Mr. Thomas Urquhart, Locomotive Superintendent, Grazi and Tsaritsin Railway, South-East Russia. The anniversary dinner will take place on Friday evening, the 4th of May.

EXHIBITION OF SAFETY APPLIANCES.—We learn from *Industries* that it is proposed to hold next year in Berlin an exhibition of appliances for insuring safety to life and limb in manufacturing operations. One of the objects of the exhibition is to bring about such legislative changes as will tend to the greater safety of workmen. The promoters have already organised sixteen separate Committees, which will deal with the following branches of the subject:—I., Safety appliances on moving machinery generally, coupling gear, winding machinery, etc.; II., appliances for use with motors and boilers; III., fire risk in artificial lighting; IV., safety appliances against poisonous gases, liquids, etc., and wearing apparel for the purpose. Committes V. to XII. deal with safety appliances to be used in the following trades: Metals wood-working textiles, paper and leather, articles of food, chemicals, glass and pottery, mining and quarrying, and building. Committees XIII. and XIV. deal with safety appliances for traffic on land and water; XV. deals with agriculture and forestry; whilst XVI. is charged with collecting, arranging, and classifying the literature on the subject. Prospectuses and regulations may be obtained, post free, from the Director of the Exhibition, Herr Max Schlesinger, Kochstrasse 3, Berlin. Applications for space must reach this gentleman not later than the 1st July.

PARIS UNIVERSAL EXHIBITION, 1889.—At the first meeting of the executive council of the British section, held under the presidency of the Lord Mayor at the Mansion House, the financial aspect of the section was fully discussed. Inasmuch as the British Government have decided not to provide funds in aid of the section, it is necessary that exhibitors should make a payment in proportion to the space which they occupy, in order to cover the charges for completing, fitting up, and decorating the courts, for general maintenance and guardianship, and for the other necessary expenses of the section. The council resolved to reduce these charges to the lowest possible amount consistent with a due regard for the proper representation of the manufacturing interests of the country—viz., 5s. per square foot. It is their intention that the utmost economy shall be exercised, and the strictest supervision will therefore be enforced over all the outgoings. But at the same time they are determined that the contributions of this country shall be shown in a manner worthy of the occasion and of the reputation which Great Britain has gained in former international exhibitions. It was also decided that in the event of there being any surplus at the close of the exhibition, it should be disposed of in accordance with the decision which might be arrived at by a meeting of exhibitors and guarantors called for the purpose. Several important additions to the guarantee fund were reported. The sum guaranteed already exceeds £12,000, and the council trust that as soon as a public appeal is made it will be considerably augmented. As the object of the council will be to insure a collective exhibition of the very highest class, it will be their aim to secure the assistance of manufacturers and others who can most worthily represent the country, and not merely to fill up all the available space. They will be glad to hear from firms of high standing who intend to exhibit, and to give them all the information in their power if they will apply at the offices of the British Section, No. 2, Walbrook (Mansion-house), E.C.

TRANSPARENCY OF THE ATMOSPHERE.—According to M. L. A. Martel (*Comptes Rendus*), the exceptional transparency of the atmosphere before rain, under a cloudy sky and especially about sunrise, is due to the absence or the suspension of the ordinary evaporation.

DIARY FOR NEXT WEEK.

Monday, April 16.—Royal Colonial Institute, at 8 p.m.—*Colonial Forestry;* by Dr. J. C. Brown.

Victoria Institute, at 8 p.m.—*Mystical Buddhism in connection with the Yoga System of Philosophy;* by Sir Monier Monier Williams.

Society of Arts, Cantor Lecture, at 8 p.m.—*Milk Supply and Butter and Cheese-Making;* by Mr. Richard Bannister.

Tuesday, April 17.—Institution of Civil Engineers, at 8 p.m.—Discussion on Mr. Arthur Ayres' paper on *Compressed Oil Gas and its Applications. The Distribution of Hydraulic Power in London;* by Mr. Edward Baysand Ellington.

Royal Statistical Society, at 7.45 p.m.—*Progressive Taxation — Some Examples from Switzerland;* by Mr. R. H. J. Palgrave.

Royal Institution, at 3 p.m.—*John Ruskin;* by Dr. C. Waldstein.

Society of Arts. Foreign and Colonial Section, at 8 p.m.—*A Hundred Years' Progress in New South Wales;* by Mr. W. F. Buchanan.

Parkes Museum, at 8 p.m.—*Water Supply, Drinking Water, Pollution of Water;* by Dr. Louis Parkes.

Wednesday, April 18.—Royal Meteorological Society, at 7 p.m. *Jordan's New Pattern Photographic Sunshine Recorder;* by Mr. James B. Jordan. *On the Meteorology of South-Eastern China in* 1886; by Mr. William Doberck. *Lightning in Snowstorms;* by Professor A. S. Herschel. *Insolation;* by Mr. Rupert T. Smith.

Society of Arts, at 8 p.m.—*Telescopes for Stellar Photography;* by Sir Howard Grubb, F.R.S.

Thursday, April 19.—Royal Society, at 4.30 p.m.

Chemical Society, at 8 p.m.

Camera Club, at 8 p.m.—*Discussion of Regulations for Photographic Exhibitions.*

Edinburgh Architectural Association, at 8 p.m.—*The Æsthetics of City Building;* by Mr. J. Crabb Watt.

Royal Institution, at 3 p.m.—*The Chemical Arts;* by Professor Dewar, F.R.S.

Friday, April 20.—Camera Club, at 8 p.m.—*Printing Methods;* by Mr. Lyonel Clark.

Institution of Civil Engineers. Students' Meeting, at 7.30 p.m.—*The Speed Trials of the Latest Addition to the "Admiral" Class of British War Vessels;* by Mr. David S. Capper, M.A.

Royal Institution, at 9 p.m.—*Antagonism;* by the Right Hon. Sir Wm. R. Grove.

Parkes Museum, at 8 p.m.—*Sanitary Appliances;* by Professor W. H. Corfield.

Saturday, April 21.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner;* by Mr. C. Ambruster.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

What offers in cash or exchange for "Symon's Monthly Meteorological Magazine," for 1884, 1885, 1886, clean and perfect?—72, Cambridge Street, Birmingham.

Chisel Steel, 1 to 5 feet bars, ⅝ to 1¾ octagon, 13s. per cwt.—GILBERT, Oxford Road, Sheffield.

Best Cast Steel for tools, taps, and dies, drills, 6d. per lb.—GILBERT, Oxford Road, Sheffield.

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Patents.—Nine months' protection, 50s.; patent completed from £6 10s.—P. M. ROGERS, 21, Finsbury Pavement.

Meerschaum and Briar Pipes Repaired, Mounted, or cased, ambers fitted.—W. GEORGE, 324, Essex Road, Islington, London.

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New Dark Room Electric Lamp, ruby, orange, white alternately, regulator to battery, 17s. 6d.—MEDLAND, Borough, London.

S. Bottone, Carshalton, supplies, post free, the following books:—"The Dynamo," 2s. 6d.; "Electrical Instrument Making," 3s.

Plating Dynamo, £2; gives six amperes, at two volts; boy works it.—A. S. BOTTONE, Electrician, Carshalton.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS. 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

Introductory Text-Book of Geology. By Professor David Page, LL.D., etc., Durham University College of Physical Science, Newcastle; and Professor Charles Lapworth, LL.D., Mason Science College, Birmingham. Twelfth edition, with engravings on wood and glossarial index. London: Wm. Blackwood and Sons. Price 3s. 6d.

Tea Cultivation and Manufacture. By E. Money. Fourth edition. Whittingham. Price 10s. 6d.

A Manual of the Mollusca. A Treatise on Recent and Fossil Shells. By Dr. S. P. Woodward, A.L.S. With Appendix by Ralph Tate, A.L.S., F.G.S. With numerous Plates and 300 Woodcuts. Fourth edition. London: Crosby Lockwood and Sons. Price 7s. 6d.

NOTICES.

The Title Page and Index to Vol. I., *First Series*, now ready, price 6d.

Binding Cases for Vol. I., *First Series*, price 2s. each.

Binding Cases and Binding, Vol. I., *First Series*, including Title Page and Index, price 3s.

Vol. I., *First Series*, bound in cloth, with Title Page and Index, 7s. 6d.—by post, 8s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet Street, London, E.C. Price 6d. each, or by post 7d. for the *First Series*, and 3d. each, or by post 3½d., for the *New Series*.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 16. (*New Series.*) APRIL 20th, 1888. [Weekly, Price 3d. By Post, 3½d.

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CURRENT EVENTS.

THE TELANTOGRAPH.—A short time since much excitement was caused by the accounts received from New York of Mr. Edison's new phonograph. By means of this instrument a spoken message could be recorded on a small strip of tinfoil, this strip could then be forwarded by post or otherwise, and the receiver could reproduce the message in the voice of the sender by placing the strip of foil in a speaking instrument. Mr. Elisha Gray, an electrician of great repute, is now said to have made important improvements in his telantograph. In this system the sender of a message writes it with a pen or pencil holder of special construction, to which are attached two fine wires which are connected with another similar pen or pencil holder in the possession of the receiver. A call signal is first given, and when the sender and receiver are both ready, the former writes his message, and simultaneously the self-same message is written by the pen or pencil in the latter's possession. There is, in fact, an exact reproduction at the receiver's end, of the message written by the sender.

Any language may be used, and the message may be written in cypher or not, as preferred. It is also stated that an outline drawing may also be "wired" and reproduced. Several inventors in this and other countries have partially succeeded in the same direction, but the present development of the system appears to have rendered it much more complete, and its importance is self-evident. Without doubt, the telephone is a most ingenious and useful instrument, and it is a decided advantage in many cases to be able to hear and identify the voice of the sender of a message. On the other hand, it is often a serious drawback that the message sent and received cannot be written or otherwise recorded There are endless cases of misunderstanding owing to the sender not speaking clearly, to the instrument being out of order, or to the receiver not hearing distinctly. All these objections, however, can be avoided if the sender writes his message, and if the receiver gets a written facsimile of the message sent.

THE EGYPTIAN EXPLORATION FUND.—We give elsewhere an interesting account of the important work being done by the energetic explorers of this society. The Fund was only started in 1883, under the Presidency of the late Sir Erasmus Wilson, but, thanks to the intelligence and skill of its workers, many valuable monuments and records have already been brought to light. The primary object of the fund is to promote investigation in Egypt by systematically conducted explorations, with a view to the solution of important historical and geographical problems, and the results already obtained show that the explorers have very practical ends in view. The work they have in hand is necessarily of great value to archæologists, but further than this it has a wide and deep interest for all concerned in the understanding of the past. Enough is known to make us wish for a larger and more exact knowledge of the remarkable people who lived and worked in the Delta of the Nile. The promoters of the fund have our cordial support, and as its good work cannot be carried on without the sinews of war, we shall be pleased if some of our readers will favour us with subscriptions for not less than £1. Subscriptions so received will be forwarded to the Secretary of the fund and duly acknowledged. We may add that each subscriber of £1 and upwards is entitled to receive gratuitously a volume giving the results of excavations, and that this volume is illustrated with maps, plates, and autotypes.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Mr. Nansen, Curator of the Bergen Museum, is about to start on a very interesting expedition to the interior of Greenland, in company with some Norwegian athletes who are well trained in snow travelling. A paragraph announcing this has appeared in many of our papers, and I find that most English readers misunderstand it. They have seen ridiculous pictures representing Laplanders standing on net-work devices resembling tennis rackets, and naturally conclude that the "snow shoes" of Nansen's expedition will be something like them.

They will be as unlike as possible. No frame or net-work of any kind; no widening of the base under the foot, but just the contrary.

They will not be snow shoes at all, but *ski* or *snow-skates;* runners five to six feet long, rather narrower than the sole of the foot, made of light but strong wood, smooth and rounded at the bottom, gracefully curved upwards, and pointed at each end, prow-like, with a strengthening ridge running along the upper part from each end to nearly the middle, where it is thicker and flat to form a stand for the foot. On this is a simple loop, into which the foot is thrust. They are remarkably light, strong, and somewhat flexible. The wearer, instead of waddling like a goose, as he must on the picture-book snow-shoes, dashes over level snow with a speed equal to that of our best skaters on ice, and flashes down the slopes at toboganing speed. He carries a *skistav*, a light staff about as long as himself, with a small circular frame at the foot, which has a little net or wicker-work to give it a bearing on the snow, but a diameter of only about three inches. He can lean upon this or check his speed by using it as a break, and also guide his rapid down-sliding.

English readers should understand that in countries having an actual winter (we have only samples here) the snow is very different from that of Cheapside. Shortly after the first fall it settles itself down respectably, and soon attains a firm *skiföre* or skating surface, over which sledges and snow-skates glide luxuriously.

Mr. Nansen and his friends "will be landed on the eastern shore of Greenland by an experienced arctic skipper, and then left to their fate. They must get across the *terra incognita* or perish in the attempt" (*Iron*, April 6th).

If their snow-shoes were of the tennis-racket pattern their fate might be easily predicted. A dozen miles a day would be about the rate of progress by such waddling, but with the ski above described (my description is based on a model I have before me that was made by a Norwegian Laplander), more than that distance may be covered in climbing steep snow slopes, which is done by placing the ski nearly crosswise to the slope and tacking upwards in a slanting course. On the down slopes and levels 50 or 60 miles per day will be done easily, or more by flying skirmishers, who will probably precede to reconnoitre, and find the best course for the provision bearers.

We must not fall into the common mistake of supposing that these explorers will suffer from the cold. On the contrary, I venture to predict, from my own experience in corresponding latitudes, that in clear weather the direct sun heat will be scorching, though tempered by the ice and snow. They will have continuous daylight until about the end of July. They purpose starting on May 5th from Copenhagen, thence to Iceland, and then across to Greenland. One account states that they are to land at Cape Dan, 66° N., and proceed in a north-westerly direction to Disco Bay. The distance overland will be about 500 miles if this course is taken.

Hereabouts is the interesting region once occupied by a flourishing Norwegian colony, with twelve parishes, a cathedral (the Garda Cathedral), and bishops duly appointed by the Pope, of which formal records remain, extending from the beginning of the eleventh to that of the fifteenth century. Then, for some unknown reason, all tidings of the colony and its 300 farms were lost, and the mystery has remained unsolved during nearly 500 years.

If the physical configuration of Greenland resembles that of Norway, as the deep fjords on its western coast all indicate, there must be, as I have long ago contended, an inner region justifying the name of the country, and with a climate similar to that of corresponding Norwegian latitudes. Some descendants of the old colonists may still exist there. It is simply a question of level. If all the interior of Greenland is a table-land like that above the Justedal, it is certainly covered with permanent ice like the great Justedal snefond, but if there are valleys with moderate slopes there will be habitable, or even richly fertile regions.

If any of my readers are sceptical, let them turn to a map of Europe and note the position and latitude of the frozen Gulf of Finland, and still further north the Gulf of Bothnia. Let him proceed up this 500 miles further north than St. Petersburg, to Tornea, formerly described as the *ultima thule* of possible travelling, where all is frozen, and described in not very old books as the southern boundary of vast regions of hopeless snowy desolation. He will then, perhaps, be surprised to learn that he may, if he chooses, take a holiday trip from Tornea and travel 500 miles further still due north, and at the end of that distance arrive at the valley of the Alten and the banks of the Kaafjord, where the sea never freezes, and where in summer, to quote the words of Murray's Handbook for Norway, "the traveller will meet as soft and pleasing scenery as any Alpine country can present," where "the fir, the birch, the willow, and mountain ash are abundant; even cornfields and cultivated meadows are seen." I am able to confirm this description by my own recollections of this charming region, which lies in latitude 70°, or about six degrees further north than the capital of Iceland.

I may add that the Norwegian army includes a corps of riflemen mounted on ski, whose evolutions are described as very remarkable and efficient.

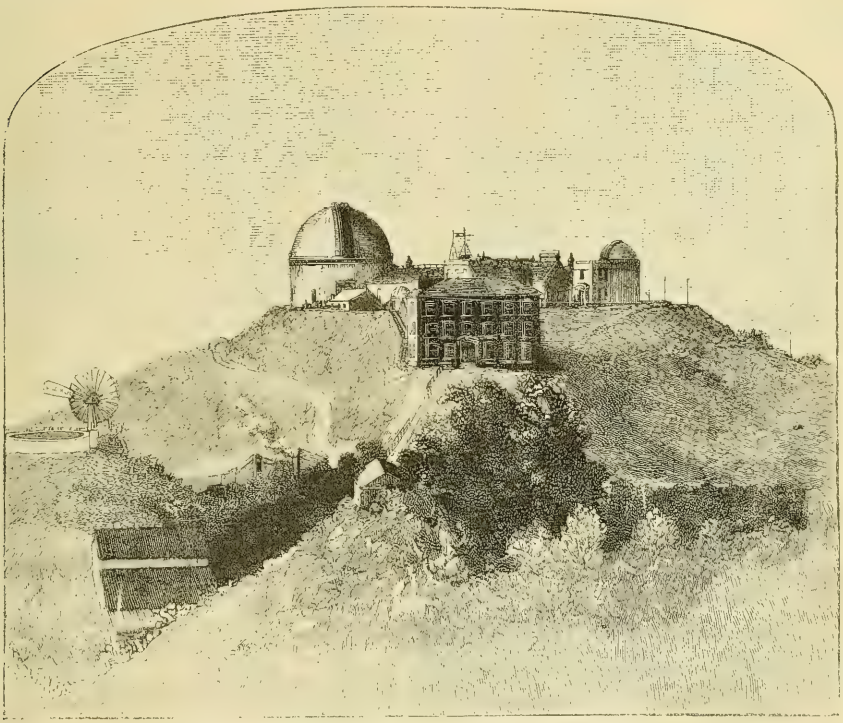
Somewhat connected with the above subject are the recent observations of Rink and Helland, who state that the great Greenland glaciers travel at the rate of 35 feet per day, while the average rate of Swiss glaciers is but 12 to 15 inches. This, if correct, indicates a great mass of ice, a vast nevé or snefond behind the glaciers pushing them onward. Nordenskjöld has proved the existence of this for some distance inland, but such may exist without by any means covering the whole of Greenland.

This rapidity of flow of the Greenland ice has an important bearing upon the questions that are under discussion concerning the period and duration of the glacial epoch, and also indicates the possibility of comparatively rapid changes in arctic climates, such changes as probably destroyed or drove inland the old Norwegian colony. We have yet, however, to learn whether the particular

glaciers on which the observations of Rink and Helland were made are fair average samples or merely exceptional. It is well known that the pace of Alpine glaciers varies remarkably with slope, temperature, etc.

But the most important factor of all is the supply of sub-glacial water due to thawing above. Now this upper thawing is especially great on arctic ice fields, owing to the continuous summer sunshine, which produces singularly hot summer weather with no cessation of thaw during the night such as occurs in summer time on the Alps. This accounts for much of the difference.

investments acquired new value, and he ultimately became immensely rich. He was a man of very secluded habits, was a skilful mechanic, and, it is said, was especially fond of astronomy. Towards the end of his life he lived near San Jose, in the Santa Clara Valley. In 1874 he made over by deed to a body of trustees the sum of 2,000,000 dols., for various public and philanthropic uses, and in 1875 made a revised deed to the same general effect. Besides various charitable donations, it included the following gifts:—150,000 dols. for free public baths in San Francisco; 100,000 dols. for



The Lick Observatory, Mount Hamilton, California.

THE LICK OBSERVATORY OF THE UNIVERSITY OF CALIFORNIA.—I.

JAMES LICK, whose name has already acquired a world-wide fame as the establisher of the Lick Observatory, was born in 1798, in Pennsylvania. He led a somewhat adventurous life, and before he was thirty years old accumulated a few thousand dollars. This he had made principally in South America, where he spent some years. In 1827 he went to California, and visited the old mission town of San Francisco. The splendid harbour, the only one on many miles of coast, greatly impressed Mr. Lick, and he began purchasing land. Twenty-one years later, when gold had been discovered, and when the rush to California began, his

statuary for the new City Hall of that city; 60,000 dols. for a monument to Francis Scott Key, the author of "The Star-Spangled Banner"; 540,000 dols. to endow the California School of Mechanical Science in San Francisco; and 700,000 dols. for procuring for the University of California "a telescope of greater power than any yet made." The total value of the trust fund was estimated at 5,000,000 dols.

As the site for his observatory he selected Mount Hamilton, near his home in the Santa Clara Valley. He died October 1st, 1876, aged 78 years. His body is interred under the base of the great telescope, which rises above his remains as a fitting monument to one of the world's greatest benefactors and philanthropists.

In administering their trust the custodians met with

legal obstacles and suits brought by his relatives. These delayed the carrying out of his plans, but eventually a settlement was reached. On June 30th, 1883, the corner-stone of the observatory to which this article is devoted was laid, and to-day the work is practically complete. When Mount Hamilton was selected as the site for the Lick Observatory, in order to test its atmospheric conditions, Professor S. W. Burnham, the discoverer of many double stars, was invited to observe there in 1879. Owing to the dryness of the air, and its excellent quality for astronomical work, his six-inch telescope divided many stars, catalogued by Professor Otto Struve as double, into triple stars. Mr. Lick died in 1876, and the original plans for the observatory were determined by Captain Richard S. Floyd, president of the trustees, and Mr. T. E. Fraser, superintendent of construction, acting under the advice of Professor Edward S. Holden and Professor Simon Newcomb, of the Naval Observatory in Washington. Many noted astronomers have been interested in the work, and this will probably be the most famous observatory in the world. It owns about 1,550 acres of land, a portion of which will eventually be made into a public park, and the graded road of twenty-six miles leading to the summit of Mount Hamilton from San Jose may, perhaps, become a direct route to the Yosemite Valley. Since 1880, when the work was first begun, 7,000 tons of rock and earth have been removed to level a plateau upon which the buildings stand. They are constructed of solid masonry, and are of simple but effective architecture, and include the main building—287 feet long—containing the directors' and secretary's offices, the library, clock-rooms, etc., with the large dome at its southern end for the large telescope, and a smaller dome for the twelve-inch equatorial at the north-west corner, the meridian circle house, the transit house, the photographic laboratory, and several temporary wooden workshops. The dwelling-house of the astronomers, 63 ft. by 60 ft., stands below the summit, and is connected with the plateau by a bridge. The surrounding peaks have been named from several famous astronomers.

The large dome, built by the Union Iron Works, of San Francisco, is 75 feet in diameter, and its moving part weigh 100 tons. It revolves upon wheels which run on hardened steel balls. A man merely pushing against it can move the entire dome. The usual motive power is obtained from a water-engine, which can rotate the dome 360° in less than nine minutes. Its diameter changes half an inch in the extreme change of temperature, and its track is given a smooth and oiled surface to slide upon. The observing slit is 9½ feet wide, and the pintle of the shutter is placed eccentrically. A practical device for carrying the observer to the eyepiece of the telescope, which at times is far above the base of the dome, was planned by Sir Howard Grubb, of Dublin. This is an elevating floor 61½ feet in diameter, weighing 50,000 pounds, movable up and down through a space of 16 feet. It is highly probable that the present system will not be sufficiently powerful to raise the flooring rapidly enough, but in this event the hydraulic system can be altered, or steam or electricity substituted. The actual speed required can only be determined after a series of experiments have been made.

The dome for the 12-inch equatorial is 25 feet wide, weighs eight tons, and its observing slit, which extends beyond the zenith, is three feet wide. The meridian circle house measures 43 by 38 feet. Its walls are double—the outer frame of galvanized iron, the inner one of California redwood. Between these is an air space 24 inches wide, which encircles the buildings. There is also an air space above the ceiling, which communicates with the room and with the air spaces of the walls, and on the west there is a ventilating tower two stories in height, which connects with the room of the meridian transit instrument. By these means the temperature of the building is kept the same as that of the external air. The transit house adjoining the meridian circle house is built of iron, with a wooden lining, and is arched by a curved shutter, which is controlled by levers, planned by Sir Howard Grubb. The photographic observatory, north of the transit house, is a small wooden building with brick foundation. The tube of the photoheliograph telescope enters this house, and a brick pier supports the photoheliograph. A room in the second floor of the main building is also fitted for photography.

The large telescope, which embodies the expressed object of the 700,000 dols. donation, was mounted by Warner and Swasey, of Cleveland. The tube is nearly cylindrical, and is 60 feet in length. There are three finders, 6, 4, and 3 inches in aperture, and in addition to these the 12-inch equatorial can be quickly attached, as a pointer, for photographic work, if the controlled driving clock does not work satisfactorily. The lens has a clear aperture of 36 inches, is the largest object-glass in the world,and has a focal length of 678 inches. The flint disk was obtained from Feil, in April, 1882, and after nineteen failures the crown-glass disk was cast successfully in September, 1885. The third photographic crown lens was purchased from Feil in 1886, and broke while in the hands of the Clarks. The trustees of Yale University then offered their 27-inch flint-glass to the Lick Observatory, but this was too yellow, and in 1887 Mr. Alvan G. Clark bought in Paris, from Feil, the crown-glass, which is worked into a third lens. In addition to its magnifying power and its perfect definition—*i.e.*, neatness, accuracy, etc.—this telescope has great light-gathering power, and stars may be seen through it which are 30,000 times fainter than the faintest seen by the naked eye, and the moon will appear under the same conditions as if it were seen by the naked eye at about 200 miles from the earth.

(*To be continued.*)

DEVELOPMENT OF THE RESOURCES OF THE WEST INDIES.—We are glad to learn that the Colonial Secretary is inviting the local authorities to co-operate in a systematic attempt to develop the resources of the British West Indies, and that his suggestions are meeting with a cordial response. The increasing export trade of Jamaica in fruits and dye-woods shows what may be done by a well-considered scheme of improvement based upon scientific principles. It is intended to have a botanic station in every island in connection with the two chief stations in Jamaica and Trinidad. Those persons who carefully examined the productions of the West Indies at the Colonial Exhibition will be well aware that these islands have still a future before them, despite the present collapse of the sugar trade.

NEW NATURAL HISTORY MUSEUM.—In the Zoological Gardens at Münster, a natural history museum for the province of Westphalia is in the course of erection.

M. PASTEUR AND THE RABBIT PLAGUE.

The Australian rabbit plague is a novel and a most instructive experience. For the first time in history we see a semi-domestic animal placed under novel circumstances, and developing into a pest, which has hitherto set all human efforts and all human ingenuity at defiance.

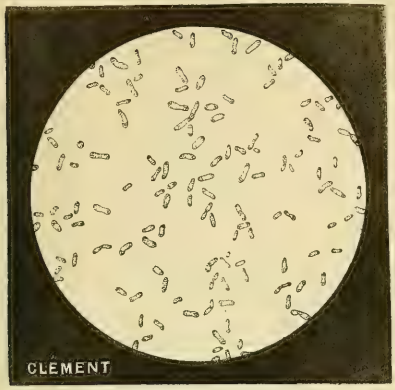


Fig. 1.—Microbe of Chicken Cholera.

We know that swarms of locusts have from time to time occasioned scarcity, or even famine. But after a time they disappear and vegetation recovers. But we cannot imagine any natural process by which the rabbit plague can be arrested. This will be the more intelligible if we remember that this scourge has been brought on simply

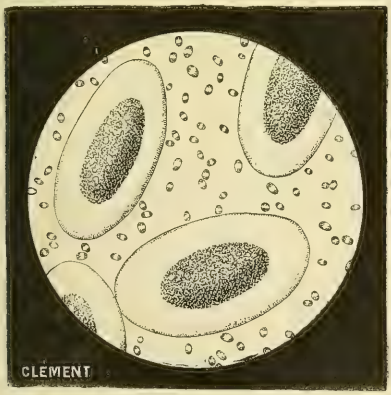


Fig. 2.—Blood Globules of a Pigeon attacked by Chicken Cholera.

by human folly. There are in England a number of men whose cherished pursuit seems to be the destruction of animal life—not for food, not to prevent any danger, but from the pure love of killing. Such men exist in all our colonies, and especially in Australia and New Zealand. As these countries did not produce animals sufficient to minister to the love of sport, rabbits were imported, without a thought as to the possible consequences. Unfortunately, the soil and the climate suited them so well that, instead of producing, as in Europe, from four to six litters yearly, each of three or four young ones, the number of litters in Australia has reached ten, and the number of young eight to ten in each. Their size and

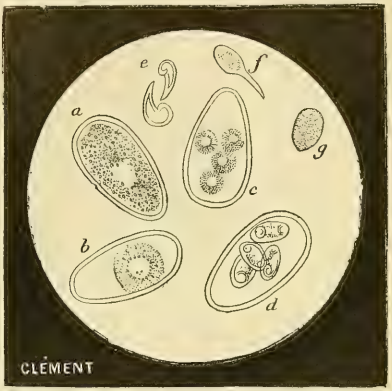


Fig. 3.—Microbe of Tuberculosis of Liver in its Different Stages of Development from *a* to *g*.

their voracity seem to undergo a corresponding increase. The gardens are devastated; lands, which yielded rich crops of wheat or barley, have been abandoned; the vineyards and the orchards have been ruined. They eat the grass down to the roots, and convert immense sheep-walks, which formerly supported ten to twelve sheep per acre, into bare, dusty deserts. None of the means employed against these enemies have led to any appreciable result. They have been hunted with dogs and ferrets; they have been shot and poisoned—but they still swarm. One extensive proprietor is said to have spent £40,000 in vain attempts to extirpate the rabbits, and has given up the struggle in disgust.

It has been proposed to introduce carnivorous animals, such as pole-cats, weasels, and the like. But these creatures multiply far too slowly to cope with such a giant evil, and were they to become numerous enough they might prove very undesirable. Poisons of various kinds have been tried, and with temporary and local success. But if all the rabbits in one plot of ground are thus extirpated, those in adjacent grounds remain, and the gap in their ranks is soon filled up.

The question, therefore, is, Shall a continent like Australia be lost to its inhabitants, to the British Empire, and to the human race, and given over to these vermin? We think that among rational people there can be but one answer: We cannot afford it! Having tried all other conceivable kinds of means, there remains but one: the use of a poison which is capable of multiplying like the enemy—in other words, of launching among them an epidemic disease.

A manner of doing this has been proposed by M. Pasteur. He selects a disease known as "chicken cholera," exceedingly infectious among poultry, rabbits, and hares, but incapable of attacking human beings, cattle, sheep, horses and swine, as it has been proved by

careful experiments. Rabbits, on the contrary, are much more susceptible to the disease than poultry.

"Chicken cholera" is one of the diseases which depend on the introduction of a minute organism into the body and its spread in the blood. The following figures, borrowed from *La Nature*, show its appearance:—Fig. 1 is the microbe of chicken cholera, cultivated in meat broth. Fig. 2 shows the blood-globules of a pigeon attacked with the disease. The efficacy of this remedy has been proved, not merely in what may be called laboratory experiments, but on a practical scale. A field of twenty acres belonging to Mrs. Pommery, of Reims, a proprietor of extensive vineyards, had become infested with rabbits to a serious degree, and their destruction was resolved on. Here, also, ferrets had been found useless. Some bundles of hay and lucern, sprinkled with a "cultivation" containing the germs of chicken cholera, were laid down in the field on December 23rd, and by the 27th not a rabbit remained alive. The disease evidently spreads from those which have eaten the infected matter to others.

M. Megnin proposes to use, instead of chicken cholera, another disease peculiar to rodent animals—tuberculosis of the liver. Fig. 3 shows the microbe of this disease in its different stages of development from *a* to *g*. This affection is rather more slow in its action than chicken cholera, but it is no less certain, and it has the advantage of not being communicable to poultry.

We must admit that, from our present knowledge, we do not see a flaw in either of these procedures, and trust that they may prove successful.

ACCLIMATISATION.—III.

(Continued from page 350.)

WHEN we introduce into any country an alien plant or animal, we have not simply the old flora or the old fauna, *plus* the new-comer. We have brought into play a disturbing element—a ferment, if I may use the comparison—and we have thus set up a process, very like decomposition, in the animal and vegetable population of the country. Each new plant that can maintain itself outside our fields and gardens, each new animal that can exist in a feral condition, intensifies the struggle for existence, and leads to the extirpation of more or fewer native species.

The thoughtless will perhaps say, "Let them fight it out, and let the best win." But the species which succeed in the struggle for existence are not the best *for us*—not the most beautiful or the most useful; often quite the contrary. It seems probable that, though "natural selection" may up to a certain point have increased the number of organic species, yet, if that point is exceeded, its action is rather destructive. In like manner, if competition between man and man were totally removed, mankind might degenerate. But if it reaches such a grade of intensity as it has done in our times, it compels men more and more to confine their attention to what is directly lucrative, overlooking all work which may lead to better things in the future. Thus original, creative minds find themselves at a discount.

How far-reaching may be the effects of the introduction of a single animal species may be seen at St. Helena and at the Cape of Good Hope. In both these regions goats were turned loose by European settlers. One of the most prominent habits of these animals is to browse down seedling trees and shrubs. In consequence, as goats multiplied, and as the old trees in the woods died off, there were no young saplings to take their place. The woods disappeared little by little; the shrubs and low-growing vegetation which had flourished in their shade perished likewise. The birds and the insects which found shelter and nutriment in the trees could not survive. In this manner the native flora and fauna of St. Helena have been so completely blotted out that their nature is a mere matter of conjecture.

Still, this is not all. When a country is denuded of woods, the rainfall, instead of being moderate and regular, is reduced to violent deluges, with times of withering drought intervening. The soil, being no longer held together by the roots of trees and bushes and by herbage, is torn away by the violent rains, and washed down into the valleys and river-beds; whilst the uplands remain barren wastes of shingle and rock, henceforth incapable of cultivation. To this state millions of acres of the finest land in the world have been reduced by acclimatisation! The men who brought the thistle and rabbit into Australia have done an infinity of harm to the human race.

This subject derives an additional importance since there is, as we are informed, no distinct law in England against importing and turning loose wolves, bears, jaguars, death-snakes, and the like.

The introduction of new plants, ornamental and useful, has hitherto been attempted in a manner anything but scientific. At present vegetal species from climates warmer than our own, if brought over, are set in places open to the sun, and sheltered from northerly and easterly winds; in case of severe frost they are protected by means of matting. Or in other cases they are raised in a cool greenhouse, moved into the open air in summer, and left out for a greater length of time, year by year, as they become stronger.

But our horticultural authorities do not seem sufficiently alive to the fact that among a large number of seedlings some may be superior to the generality in resisting low temperatures. We learn from Mr. Jenner Weir that a great number of begonias which a nurseryman had intended to house for the winter were overtaken by one of the morning frosts which occurred so unseasonably in the autumn of 1885. All the plants, save one, were cut off. It seems by no means unlikely that, if young plants were propagated from this resistant individual, some one or more of them might be found still hardier than the parent, and thus, by a process of selection, we might, in the course of successive generations, arrive at a strain of begonias—and, in like manner, of other greenhouse plants—which should flourish in the open ground.

By a similar process of selection we might seek to develop fruit-trees which should come into blossom later than the ordinary strains, and thus escape the action of spring frosts. It would, of course, be also needful to aim at the production of varieties which mature their fruit in the shortest time. The essential question here, to be answered by experience only, is whether the power of bearing low temperatures, of blossoming late, and yet ripening fruit early, can be obtained without a sacrifice, greater or less, of the valuable properties of the various fruits. But in so untrustworthy a climate as ours, where a temperature of 24° Fahr. may be experienced as late as May 8th, the development of such strains or varieties should be aimed at if our soil is to yield its cultivators fair remuneration, and is to be secured from falling back into the barbarous condition of "permanent pasture."

General Notes.

Poisonous Adulteration.—Two bakers in Philadelphia who had occasioned a number of deaths by adulterating pastry with chrome-yellow (lead chromate) have, on conviction, been merely sentenced to nine months and six months imprisonment respectively.

Artificial Production of the Diamond.—Dr. Cailletet, well-known for his success in liquefying the so-called permanent gases, is now attempting the artificial production of the diamond by the combined action of high-pressure, heat, and electricity upon chalk in condensed carbonic acid.

Fixation of Atmospheric Nitrogen by the Soil.—MM. Arm. Gautier and R. Drouin (*Comptes Rendus*) show that in the absence of organic matter there is a gradual loss of nitrogen, whilst if organic matter is present—as in all natural arable soils—atmospheric nitrogen becomes fixed.

Scientific Habits of Thought.—The *Popular Science Monthly*, in discussing this subject, says :—"The expression 'schools of thought' even is one not to be accepted without caution, seeing that no one should wittingly attach himself to any school save the great school that Nature keeps open for all."

Unification of the Calendar.—Russia and other states still using the "old style" have resolved on accepting the Gregorian Calendar by degrees, suppressing every 29th day of February for half a century. The unification will be complete by January 1st, 1941.

Colliery Explosions.—Mr. Harris contradicts the general belief that colliery explosions are always attended by a low barometer. In Sir F. Abel's list of disasters in the years 1875-85 only 18·75 per cent. of the accidents and 17·4 per cent. of the deaths took place when the mercury was at 29½ inches, or below. Of this small percentage of explosions one half took place with a low, but rapidly rising barometer.

Climatological Review for February.—M. A. Lancaster (*Ciel et Terre*) reviews the weather for February last. On only two occasions for more than half a century has the month been colder, *i.e.*, 1845 and 1855, when the thermometric means were respectively −2·7° and −3·5°. In 1845 there were 27 days of frost, and in 1855, 22. This year the mean temperature of February has been −0·8°, *i.e.*, 4·6° below the average, and 19 days of frost.

Speed of Transmission of Earthquake-Shocks.—Prof. Newcomb and Mr. Dutton have examined the speed of propagation of the Charleston earthquake of 1886. Taking as the basis of their calculations the times marked by clocks stopped by the shock at different places they find the velocity of transmission was 16,000 feet per second.—American *Journal of Science*. This agrees with the fact that on the explosion of a magazine the shock is transmitted underground and may effect damage *before* the sound reaches the place.

Earthquake in Wales.—On April 11th shocks of earthquake were felt in various parts of North Wales. At the large Baptist Chapel, Llangollen, while service was proceeding, the shock was distinctly felt, and the walls and ground were seen to shake. Shocks were also experienced at many of the residences in the valley, where the crockery and windows quivered in their places. A farmer residing at the Craig said that his farmstead shook so much that he expected it to fall. The shocks were also noticed at Corwen, Bala, and Dolgelly.

The Rabbit Plague in Australia.—Says *Science Gossip*, there is an ingenious scheme by which the rabbits are perpetuated. A price per head is offered for them, and a new industry has sprung up at the Antipodes. It pays the rabbit exterminators to keep the rabbits from extinction. In case of the last event their occupation would be gone. In one colony the Government offered so much per dozen rabbit-heads, in another per dozen rabbit-tails. Forthwith there was business done, the rabbit-catchers in the one colony dealing in tails, and those in the next in heads, exchanging with each other to get double Government grants.

Utilisation of Carboniferous Schists.—Herr von Schlieber, of Berlin (*La Nature*), has devised a process for separating mechanically the two chief constituents of coal-shales, namely, coal and clay. The material is first ground to a fine powder and then exposed to washing in an apparatus similar to that used in washing gold. The coal is first deposited in the channels, whilst the water flows into large tanks and deposits there the particles of clay which it holds in suspension. The coal-powder thus obtained is used in the manufacture of "briquettes." Of course the value of this process turns on the price of coal in any district.

Effects of a Siberian Winter.—At Werchojanok in Eastern Siberia, says *l'Astronomie*, where the thermometer has been known to fall to 68° below zero Centigrade, the following effects have been produced :—A threefold covering of reindeer skin scarcely suffices to hinder the blood from freezing. Every respiration causes a painful sensation in the windpipe and the lungs. The moisture of the breath freezes instantly, becoming converted into fine needles of ice, the friction of which against each other produces a sound like that of tearing of silk. On a journey the entire party in enwrapped in a blueish mist formed by the breath of men and animals. A raven which flew slowly past left behind it a long train of frozen vapour.

Stagnant Water and Bad Milk.—Professor Law, of Cornell University, caused some cows to drink for several days from a stagnant pool of water, and having examined the milk found it full of living organisms. Then the water from the pool was examined, and the same living creatures were found. Then the cows were examined, and they were found to be in a feverish condition, the result of their blood being charged with these minute organisms. Then some pure milk was taken and some of this pond water put with it, and these same creatures multiplied within a few hours so as to take possession of the milk. After this test no one can dispute that living organisms may be introduced into milk by the using of improper food and drink. It also shows that there is a close relation between good pure water and

fine good keeping dairy products. From a sanitary standpoint the lives and health of the consumers are, to a certain extent, dependent upon the character of butter and milk. Cleanliness can alone be tolerated in the dairy and its surroundings.—*Farmer's Gazette.*

Nature-Smelted Iron.—Curious samples of naturally reduced iron have been found on the North Saskatchewan River, in the north-west territory of Canada, about eighty miles from the town of Edmonton, Alberta. Along the river bank a lignite formation crops out for several miles, overlaid by clay shale and soft argillaceous sandstone containing nodules of clay ironstone. These nodules are similar to others found at Edmonton, and proved on analysis to be carbonates of iron containing 34·98 per cent. of metallic iron. The Saskatchewan seam of lignite has, at some time or other, been burnt, leaving a bed of ashes, clinkers, and burnt clay, in places twenty feet thick, and now covered by a dense growth of grass and underwood. From this mass of burnt clay pieces of metallic iron can be picked out, weighing in some cases 15 lb. or 20 lb. They have evidently been reduced from the nodules above mentioned by the heat of the burning lignite. Most of the pieces of iron are much rusted, but when scratched with a file they show a bright surface. The observation is interesting, and to some may help to explain how primitive man originally discovered the reduction of iron ore.—*Iron.*

Rousdon Observatory.—Mr. Cuthbert E. Peek has issued the fourth annual report of the well-equipped meteorological observatory which he has established at Rousdon, on the border of Dorset and Devon, near Lyme Regis. The observatory is a second order station of the Royal Meteorological Society, and the observations by means of the various instruments have been most efficiently carried out during the past year. The rainfall at Rousdon was much below that of seven selected stations within 25 miles; the total rainfall at Rousdon was 25·33 inches, as compared with the mean rainfall at the stations of 33·03 inches. Mr. Peek continues his daily comparison of the weather experienced at his observatory with that predicted for the district in the forecasts of the Meteorological Office. The results, so far, show increasing success during the four years for which the comparisons have been in progress. Of the total forecasts issued in 1887, 75 per cent. were reliable for wind and weather; 83 per cent. wind reliable; 9 per cent. wind doubtful; 8 per cent. wind unreliable; 82 per cent. weather reliable; 11 per cent. weather doubtful; and 7 per cent. weather unreliable. This is, on the whole, very satisfactory. Mr. Peek has been carrying out evaporation experiments during the year, with very carefully adjusted apparatus.

Alleged Action of Drugs at a Distance.—A Commission of the Paris Academy of Medicine has recently been investigating the supposed action of medicines at a distance, as asserted by M. Luys. This gentleman was first allowed to repeat his experiments before the Committee. A series of check-experiments was then undertaken. Various medicines were prepared and inserted in phials marked with a number. Each number corresponded to a sealed paper in which was inclosed the formula of the medicine. When the phials of M. Luys (which were capable of being recognised) were used certain symptoms were caused which seemed to be in harmony with their contents. This was no longer the case with the tubes prepared by the Committee. It was found that one and the same phial placed on the left side of the patient induced very frequently sentiments of terror, sadness, or aversion, whilst if transferred to the right side it occasioned laughter, joy, satisfaction. Furthermore, empty phials often produce more marked and more energetic effects than most of the medicines tried. It need, therefore, scarcely be said that the phenomena observed belong to the sphere of hysteria. In presence of these facts the Committee, whilst recognising the entire good faith of M. Luys, decide that the effects produced upon hypnotizable subjects of medicines placed at a distance depend more on the caprice, the imagination, and the recollections of the subject than on the nature of the substances inclosed in the phials. Neither therapeutics nor medical jurisprudence has any need to take account of the phenomena said to have been produced.

The Ramie Plant.—The British Consul at Barcelona, in a report on this plant, gives the industries to which it is applicable. The qualities of ramie are almost similar to those of flax, hemp, jute, and other textiles of the same family, and it may be substituted with advantage where resistance is necessary in stretching, as in some threads, cords, tickings, hoses, etc. Manufactures from ramie possess greater resistance and durability than those made from jute, which Mr. Wooldridge appears to think it will entirely supplant. Its price is the same as flax and hemp, while the separation of the fibres and the combing and threading is done with the machinery employed in the linen industry without increasing the price. Moreover, double the quantity of cloth can be manufactured from ramie as from the same weight of flax and hemp, and the texture thus made, besides being half the price, is "lighter, more solid, and less liable to rot when in contact with moisture." It can never be substituted altogether for cotton, but may be mixed with the latter with advantage. But the Consul thinks it is destined to act an important part in conjunction with wool and silks. The mixture with the latter would produce tissues more durable and with a more lasting gloss than the present combination of silk and cotton. Thread and string made from it will be stronger and more lasting than cotton, and have a flexibility difficult to obtain from either flax or hemp. It is said that even now much of the thread that is sold in England as silk is made from ramie. There is no difficulty in colouring it; indigo is best for blue, saffron for rose, the castor-oil plant for orange brown, and turmeric for yellow. It also preserves the colour better than other fibres. Senor Obiols, Professor of Agriculture at Barcelona, declares that ramie is a most valuable industrial fibre; thread can be made from it to imitate cotton, with the advantage of greater strength and durability; all kinds of linen, stuffs for trousers, shirts, sails, sackcloths, cordage, etc., can be made of it, as well as lawns and fine lace. He thinks its cultivation will throw that of wine into the shade in parts of Spain; it produces three harvests a year, and it will become popular, as it requires a minimum of labour. Moreover, machines are already in use which are able to decorticate it on a profitable scale.

EXPLORATION IN EGYPT.

IT is well known that we owe the home-bringing of the Alexandrian Obelisk, now standing on the Thames Embankment, to the generosity and energy of the late Sir Erasmus Wilson.

The voyage, the shipwreck, loss, recovery, and the passing through the Law Courts of this famous Needle, are still fresh in our memories. But it is by no means widely known that the work of Sir Erasmus Wilson, in connection with Egypt, did not end, but rather began with the bringing of this treasure to England. Jealous that to France and Germany alone should be left the honour of uncovering the past history of a country with whom England has in later times had such stirring relations, Sir E. Wilson, in co-operation with Miss Amelia B. Edwards, and Mr. Reginald Stuart Poole of the British Museum, founded and organised the Egypt Exploration Fund, and through its instrumentality, discoveries since the year 1883 have been made in the Delta, of the deepest interest to all students of history.

The objects of the society, of which Sir Erasmus became the first president, may be gathered from its own rules :—

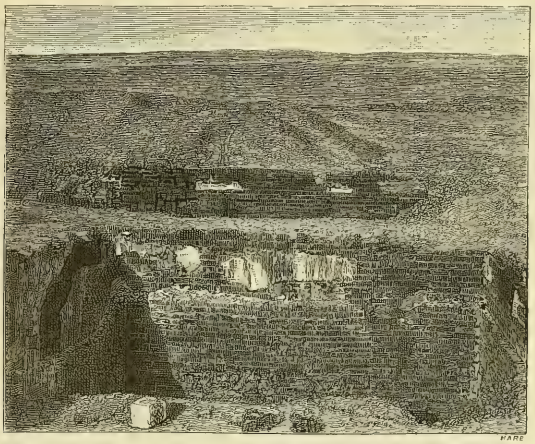
"(*a*) To organise excavations in Egypt with a view to the elucidation of the history and arts of ancient Egypt, and the illustration of the Old Testament narrative, so far as it has to do with Egypt and the Egyptians; also to explore sites connected with Greek history or with the antiquities of the Coptic Church.

"(*b*) To publish periodically, descriptions of the sites explored and excavated, and of the antiquities brought to light.

"(*c*) To ensure the preservation of such antiquities by presenting them to museums and similar public institutions."

The first operations of the society were directed to the Delta. Scattered over the low-level lands between the mouths of the Nile, are numberless mounds, under which lie hidden the remains of ancient cities, all built on slight eminences, which once were part of the bed of the Mediterranean and covered by its waters. These mounds, which are made up of the accumulated strata of ruins of each succeeding period, are rapidly disappearing year by year, as the peasantry of the country dig out the heart of them for the light bricky soil, to spread as manure over their fields of barley and clover.

Where blocks of temples and drums of columns are found (all more or less inscribed with valuable historical records), the Arabs drag them to the lime kiln; and statues and shrines are broken up, to find the secret treasures of gold and silver which are supposed to have been locked up within them by the magicians of olden time.



THE MOUND OF MASKHÛTAH, SHOWING THE STORE CHAMBERS.

(*From a Photograph by Mr. W. M. Flinders Petrie.*)

Students may bewail the ruthless burning of the books of the Alexandrian Library, but here, in our own time, volumes of history and contemporary records of periods almost unknown to us, are being systematically consumed in the kilns of the Fellahîn.

The *raison d'être* of the Egypt Exploration Fund is to save what, if once lost, can never be recovered.

The Society began in 1883 by engaging the services of the eminent Egyptologist, M. Naville, as an explorer. The following year, Mr. W. M. Flinders Petrie, who had already spent two long seasons in Egypt, and had distinguished himself by the production of his masterly work on "The Pyramids and Temples of Gizeh," placed his services at the disposal of the Committee of the Fund, and went out to Sân—the "Tanis" of the Septuagint and the Greek historians, the "Zoan" of the Bible—where for five months he conducted the important excavations which form the subject of his work on "Tanis," the second memoir published by the Fund. The following season,

1885, the same indefatigable explorer discovered and partly worked the site of the long-lost city of Naukratis, the famous Greek Emporium, of which we read in the pages of Herodotus and Athenæus; and to this site he returned in 1886, accompanied by Mr. F. Llewellyn Griffith and Mr. Ernest A. Gardner (now Director of the English School at Athens). These gentlemen who are exposed to severe hardship, and who work often at great risk to life and health, receive no payment whatever, the explorers being simply reimbursed for actual outlay.

They were fully empowered by the Egyptian Government to conduct the work they had taken in hand, on condition that all objects discovered should be submitted to the authorities of the National Egyptian Museum at Boulak; and it was further conceded that when the claims of the Egyptian Collection should be satisfied, the remaining objects should be at the disposal of the Fund. The Committee of the Fund accordingly divide the objects thus acquired between the British Museum, the Museum of Fine Arts, Boston, U.S.A., and various local museums in Great Britain and America.

M. Naville's first discovery, that of the site of Pithom, is perhaps of the widest interest to English readers as being connected with one of the best-known passages in Biblical history, viz., the oppression of the children of Israel by Pharaoh — Rameses II. of the XIXth Dynasty.

Lower Egypt is intimately bound up with the early fortunes of the Hebrew nation—the South-eastern Delta being for five hundred years as much the fatherland of the descendants of Jacob as modern Egypt is now of the descendants of Amr's Arab hordes. The pastures of Goshen were theirs by right of gift and settlement. With their oppression by Rameses the Great begins the most dramatically interesting part of the Old Testament narrative. The first chapter of Exodus tells us that "they built for Pharaoh treasure cities, Pithom and Raamses," but until M. Naville, excavating on the banks of the Freshwater Canal, near Tel-el-Maskhûtah, dug out the very store chambers which the hands of the Israelites had raised thirty-three centuries ago (about 1400 B.C.), the sites of these cities were but conjecturally identified.

The city thus discovered was at first supposed to be Raamses, and, indeed, the few modern houses there bore that name; but the statues and inscriptions which were subsequently found proclaimed it to be the twin city Pithom, the "Succoth" of the Hebrews, in the surrounding district of which they halted on the first day of the Exodus. The problem of the route of the Exodus was therefore, by the discovery of Pithom, at last finally solved.

Here M. Naville, with the 100 native workmen he daily employed, brought to light a great wall 24 ft. thick, some remains of a temple, and those curious subterraneous structures which we may designate as granaries, magazines or store chambers. They are square, solidly-built cellars of all sizes, divided by walls 10 ft. thick, and having neither doors nor windows, so that they were probably destined to be filled or emptied from the top.

The faultlessly perpendicular walls are of brickwork, the surface of which is as smooth as mere Nile mud can be made; and they are bedded in with thin mortar. M. Naville turned over thousands of these bricks, without finding a single royal mark of the Pharaoh stamped upon them, like the one in the Berlin Museum which Lepsius states came from this very site.

It would be difficult to find a more curious confirmation of a minor historical detail than that which M. Navilles' report gives to the fifth chapter of Exodus. He tells us the bricks are of three qualities; the best being properly mixed with straw; the next, in the absence of straw being made with reeds (rendered "stubble" in the Bible); and the worst consisting only of mud, when the supply of reeds was exhausted.

From the accompanying illustration it will be seen that the Israelite workmen laid their bricks with headers and stretchers, in the manner we should now technically describe as the "Old English Bond," though henceforth it might be more correct to designate it as the "Old Egyptian Bond."

Of the succeeding *trouvailles* of the Society, space forbids us to make more than passing mention. The valuable papyri, bronzes and sculptures found by Mr. Petrie at Tanis-Zoan in 1884; the lost Greek city of Naukratis, with its hoards of archaic pottery and terra-cottas, which the same untiring excavator brought to light in 1885; his discovery in 1886 of "Pharaoh's house at Tahpanhes," described by the prophet Jeremiah, where was uncovered the very entry to the Palace, where the prophet delivered his famous prophecy of warning to the "men of Judah"; the excavation of an ancient Jewish necropolis at Tel-el-Yahoudeh in 1887, by M. Naville; and, finally the discovery of Tel Basta, and of its temple of red granite, which Herodotus mentions as the most beautiful in all Egypt—all these (with the exception of Tel Basta, the account of which is not yet published) are fully described and illustrated in the works issued by the Society, and specimens of some of the most valuable objects found are to be seen in the British Museum.

How much more may be brought to England to enrich our national collections, will depend upon the liberality with which the public supports the Egypt Exploration Fund in its great and costly undertakings.

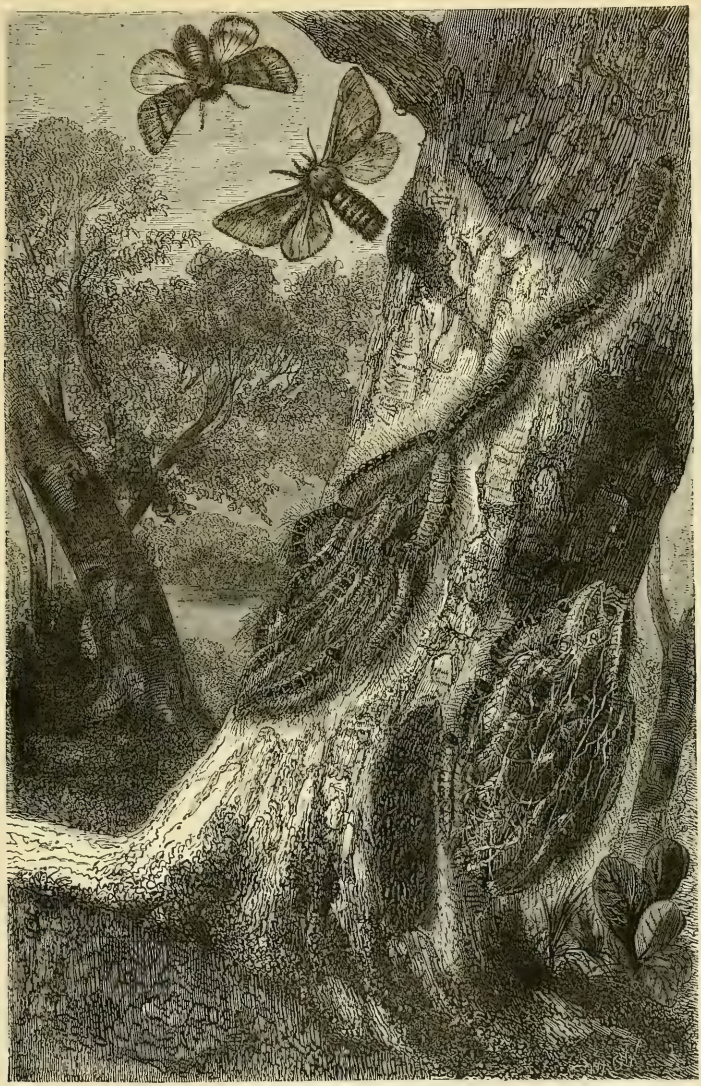
STEAM-HEATING OF RAILWAY CARRIAGES.

THE heating of cars by steam has at last met with a genuine experience with the worst conditions that it can expect to ever be called to meet—viz., the bitter cold and blockading snow of a veritable north-western blizzard. From the 12th to the 17th of last month a steam-heated train on the Chicago and North-Western Railway struggled with snow and cold on a special run from Chicago to Des Moines, Iowa, 363 miles, and return. Seventeen hours of this time were spent in a snow-drift. During the trip the temperature of the outside air ranged down to 29 degrees below zero. The cars were kept comfortable through all this. When the engine was detached to seek release from the snow-drift, the cars were kept warm with the Baker heaters. Steam-heating is shown in this experiment to be here to stay, despite the cavil of unbelievers, for it has successfully carried a train through conditions that reach the maximum of severity in our latitudes. But it has also been shown that we are as yet only upon the threshold of the science of steam-heating, for these severe conditions have brought out defects that must be removed before ordinary train hands can be trusted to carry it into a blizzard. We confidently expect that these defects will be remedied.—*Railway Review.*

Natural History.

PROCESSIONARY CATERPILLARS.

The caterpillars of certain species of moths have a very curious habit. They form, in common, a large nest of silk, in which they spend the day. At the approach of night they sally forth to feed, not promiscuously, but in the form of a regular procession, until they reach the part of the tree which they intend to ravage. Some species, when they have consumed the foliage of one tree, descend the trunk and march on, a compact column, along the ground until they find another tree which suits their tastes. A "ranger of Crown lands" in the service of the South Australian Government, informs us that he saw one day, crawling



Processionary Caterpillars.

along in the bush, what he took at first to be a very large serpent, but which on closer inspection proved to be a dense column of caterpillars more than twelve feet in length.

The European "processionaries" have never been known to collect in such enormous numbers, but they may justly rank among the most injurious insects known. Not only do they occasion great damage in woods and plantations, but their hairs, which are detached by the slightest friction or even by the wind, are dangerous both to man and to domestic animals. If they come in contact with the hands or the face they occasion violent irritations. If drawn into the mouth or nostrils serious inflammation of the mucous membranes ensues, and occasionally proves fatal.

The remedies proposed for this affection, when external, have been tried by Dr. Champouillon upon himself. He finds that when the inflamed spots are few and far between, relief is obtained on covering them with crushed parsley. If the inflammation is more general, baths of salt water or of carbonate of soda are found useful. In attacking the nests of these caterpillars it is advisable to advance from the windward, and to keep the mouth and nostrils covered with a fine cloth.

It is a curious but discreditable fact that the hairs of such, and of similar caterpillars, have figured in the annals of secret poisoning. We use the term "poisoning" with reservation, since it appears probable that the injury occasioned by these hairs depends more on the mechanical action, due to their barbed points, than on any deleterious chemical principle present.

The chief European species of this group are *Cnethocampa processionea*, which is found in France and the south and west of Germany. It attacks oak woods in the months of May and June, and often completely strips them of their leaves, to the no small injury of the trees.

Cnethocampa pinivora commits similar havoc in the pine-forests of Eastern Germany, the south of Sweden, and the west of Russia.

Cnethocampa pityocampa attacks the pine, and is more dreaded than the oak-processionary. The reason for this lies in the nature of the tree. If an oak be stripped of its leaves in the early part of June it puts forth a second crop about midsummer. But to a pine-tree the entire loss of its leaves is generally fatal.

The *pityocampa* haunts the woods of Southern France, the Tyrol, and Illyria, and its hairs are more dreaded even than those of the oak-processionary. In order to destroy these pests, the cocoons are dragged down from the trees by means of hooked sticks raked together and burnt.

Cats v. Rabbits.—According to the *Australasian*, the domestic cat is really of practical value as a rabbit-destroyer. It seems that Mr. F. W. Armytage has an estate in Victoria of some 20,000 acres, which, like those of his neighbours, was sorely infested with rabbits. The extent of the infliction may be guessed from the fact that, though the trappers sent away the skins of some 50,000 annually and many more thousands were killed in battues, not to speak of their occasional destruction by poison, the pest remained practically unabated. Then it occurred to Mr. Armytage to try cats. He put a stop to trapping, and in consequence was denounced as the "poor man's enemy." He introduced a number of cats —some three hundred or so—and the "poor man" contrived to destroy a third of the number. But those that were left did their work. A rabbit-proof fence prevented an increase to the number of rabbits from without, and the cats pretty well disposed of those within. It is true they had for auxiliaries a man and a large kennel of ferrets; but, even with this help, the work they did was very notable. In the 20,000 acres, it is said, "the number of rabbits now left on the estate is scarcely larger than Mr. Armytage would like to have, as he is fond of having a few friends out for a day's shooting." It was noticeable, too, that the cats had committed little depredation on the small birds, for these, when "Bruni" visited the estate, were in abundance, and singing merrily. Naturally the inference suggests itself to the writer that, if cats could do such good work in a comparatively limited estate in Victoria, they could do much better in the large stations of Central Australia, where they would be free from their relentless enemy—the rabbit trapper.

The Sensitiveness of Plants.—Professor Baillon has communicated to the French Linnean Society the results of his experiments on the curvature of the tendrils of *Cissus discolor*. The slightest friction applied to one of the two branches of the tendril occasions on a few moments a curve concave to the point rubbed. If both sides of the tendril are equally rubbed, no flexion takes place. These facts confirm the fundamental uniformity of the substance which, alike in plants and animals, forms the physical basis of life. The phytoblast is thus of an animal nature, like the sarcode. Our readers will recall how exactly this agrees with the conclusions of Charles Darwin, who had experimented on the very same plant, and who was of opinion that plants, *e.g.*, the *Drosera*, possess a substance analogous, at least in its constitution and its functions, to nerve-matter.

Poisonous Fishes.—An interesting feature in the "Fisheries" Exhibition, now open at Havre, is a collection of poisonous fishes. A tehodon found in the Japanese seas is so poisonous that it is sometimes used as a means of suicide. The symptoms produced resemble those occasioned by an overdose of morphia.

Curiosities of the Senses.—According to a memoir communicated to the Biological Society of Paris by M. Mathias Duval, and reported in the *Siècle*, it is not advantageous when looking through a telescope with one eye to close the other, but rather the contrary. We have not succeeded in verifying this observation with the microscope.

Natural History of the Isle of Man.—Dr. P. Q. Keegan (*Science Gossip*) gives a very interesting sketch of the geology, mineralogy, and botany of the Isle of Man, but leaves its zoology untouched.

Instinct of Birds.—Under this title the *Journal of Microscopy* quotes a report that in Peru and other parts of South America last year's fruit has been avoided by birds, while it has caused the death of sheep and cattle which fed on it in large quantities. These observations have been cited as tending to show that the instinct of birds, with respect to the wholesomeness of fruits is frequently a worthy guide for human beings to follow. The possibility is suggested that the variation in the fruit of different years may have something to do with the outbreak of cholera.

DEATH SNAKES IN SOUTH AFRICA.

THE following account of the most poisonous species is communicated to the *Field* by a correspondent using the pseudonym "Ingomayana":—"The largest cobra (*Naia haie*) is of a yellow or reddish-yellow colour. According to Sir Andrew Smith, there are four varieties of the Cape cobra. The largest I ever saw measured exactly 6 ft. in length. It was killed in my garden, and I measured it myself with a tape line. Most snake stories are so improbable as not to be deserving of serious notice. It is no unusual thing, for example, to hear it asserted that a cobra when irritated will chase a man on horseback for miles. This of course is nonsense, for no snake, if it had the inclination, has the requisite speed for such a performance. It is true they glide with amazing rapidity, but the speed is more apparent than real. Bushmen look upon a well-cooked snake as a delicacy, every portion of which they devour, with the exception of the head, which they chop off.

"The *spungh-slang*, or spitting snake (a variety of the *Cobra capensis*, in colour intermediate between straw-yellow and pale cream-yellow), is also a dangerous reptile, combining, as it does, the power of ejecting its poison as through a squirt. Its length is about 6 ft., with a large flat head, and when angered it exhibits extreme ferocity. This extraordinary peculiarity of spitting poison has been frequently discredited and ridiculed as being purely imaginary, although the existence of the spitting snake has been familiar to naturalists for a number of years. A colonist whom I knew, a man of keen observation, told me that, having heard many marvellous tales in connection with this peculiar power, he resolved to avail himself at the first opportunity of proving their correctness or otherwise. When riding along the public road one day, he was challenged by one of these reptiles, which raised its head several inches in a defiant manner above the low bush that it occupied. The narrator at once seized the opportunity, and, having a companion with him, it was arranged that one should look the creature full in the face, whilst the other irritated it by throwing stones into the bush wherein it lay. This so exasperated the creature that the moment it caught sight of my informant it let fly a charge of poison, evidently aiming at the eye of its human antagonist, with the liquid of which the poison is said to infuse itself, causing death. In this instance, however, the poison, happily, did not enter the eye, owing perhaps to the distance (eight or ten yards); it only lodged upon the cheek-bone, about an inch below the eye, and being immediately wiped off, no injurious results followed. Next to the cobra, the puff adder (*Vipera arietans*), of a brown colour, chequered with dark brown and white, ranks as the most poisonous of South African snakes. It attains a length of 4 ft., or 4 ft. 6 in. Its circumference equals that of a man's arm; it has a very broad head, and the tail tapers suddenly. It is indolent in its habits, and may often be heard to snore loudly at noonday. It is safer to pass by the head than the tail of a puff adder, because it possesses the singular power of throwing itself backwards over on its tail when it wants to strike. It derives its popular name from its practice of puffing out, or swelling its body when irritated. Vipers are the only snakes of South Africa that permit themselves generally to be closely approached without evincing any apparent alarm or concern.

"The *hornsman*, or horned snake (*Cerastes lophophrys*), of a rusty brown, and about 18 in. in length. is also a formidable reptile. It is short, and very thick at the head, slow in its movements, and, because of its shortness, it can conveniently lie in a footpath, and creep into the huts of the natives.

"The familiar and diminutive night adder (*Cyrtophis scutatus*), of a straw-yellow colour, variegated with liver-brown, and about 9 in. in length), is an extremely dangerous reptile, owing to its insidious habit of crawling about at night, often biting travellers when sleeping in the open. Should anyone take possession of a bush for the purpose of sleeping under its shelter, in which a night adder is concealed, the latter commences to hiss furiously, thus providentially warning one of his danger, when of course, the hint is taken, and the dangerous locality vacated at once. Although the bite of this small snake does not destroy life as speedily as that of the larger sort, it is nevertheless fatal. I will conclude by briefly enumerating the remaining venomous snakes of which I have personal cognizance, viz.: The *ring hals* (*Naia hæmachatis*), the *das adder* (*Clotho nasicornis*), the *berg adder* (*Clotho atropos*), and the *schaap sticker* (*Pasammophylax rhombeatus*)."

A communication which we some time ago received from Natal identifies the puff adder, "ibululu" of the Caffirs, with *Daboia Russelli* of India, but gives the same account of its habits. "Ingomayana" does not mention the smaller puff adder, or inshlangwane, *Echis carinate*. The night adder, enshlangu, our correspondent identifies with the *Bungaris fasciatus* of Fayrer.

The assertion that serpents spit out venom demands further inquiry. But that the venom of the more formidable kinds would prove fatal if applied to the eye or to any mucous membrane is beyond question.

THE UNIVERSAL DAY.

OF all the periods of time marked by the regular movements of the heavenly bodies, the most practically important in connection with human affairs is the solar day. This portion of time is determined by the daily revolution of the earth on its axis, involving the alternation of light and darkness. It is not always of the same length, because of the inclined position of the ecliptic and the changing motion of the earth in its revolution round the sun. But the mean solar day is the time in which the earth would make one revolution on its axis, as compared with the sun, if it progressed at a regular speed in one plane. Its difference from the true solar day is so small as to escape ordinary notice, unless after a certain period. By the accumulation of these differences—day by day—the sun is at the beginning of November 16½ minutes fast, and at the middle of February 14½ minutes slow. During this period of about 100 days fully half an-hour has been lost. It is on this account that in November the mornings are half-an-hour longer than the afternoons, whereas in February the mornings are half-an-hour shorter than the afternoons.

The sub-division of the day into 24 hours has been generally prevalent among all nations. But the particular point at which the day is said to commence has varied very much. The ancient Egyptians fixed the beginning of the civil day at midnight; and this arrangement prevails pretty generally in European countries at the present day. By these the 12 morning hours are reckoned from midnight to mid-day (or noon), and the 12 evening hours from mid-day to midnight. The former

hours are called a.m. (ante meridiem) or forenoon; and the latter are called p.m. (post-meridiem) or afternoon. Ptolemy, the first great astronomer, regarded the day as commencing with the sun's highest position in the heavens, or at noon; and astronomers still make the astronomical day commence at mid-day, as it is the most convenient for their calculations. Hipparchus reckoned the 24 hours from midnight to midnight without the division into two halves at noon. The ancient Chaldeans chose sunrise for the commencement of the day; and the Modern Greeks have followed their method. The Italians and Bohemians make sunset the commencement of the day. In these cases of sunrise and sunset the commencement of the day will vary with the seasons, as the countries are not under the equator. From the earliest ages of the Roman Empire, until about 300 B.C., sunrise, sunset, and midday were the only periods of the day that were defined. Midday was marked by the arrival of the sun between the Rostra and a place called Graecostasis, where Grecian and other ambassadors were accustomed to stand. The Greeks divided each natural day into 12 hours; these were called temporary hours from their unequal length changing according to the seasons of the year. The Jewish day-watches commenced at our six in the morning, the second at our nine, the third at noon, and the fourth at our three in the afternoon; and the night-watches at the corresponding night hours.

The Astronomer-Royal (Mr. Christie), in an able address before the Royal Institution of Great Britain, directed the attention of business men at home and abroad to the extreme importance of putting a stop to the various ways of determining the day, and of agreeing upon a uniform system. Throughout Great Britain railways (with their *Greenwich* time) have done much to regulate the time in inland districts, yet it is still a very common thing to find the people adhering to the local time. A clergyman in a Highland Presbytery of Scotland, who had driven from the railway town to do duty in a secluded church twenty miles inland among the hills, would be likely to find a considerable difference in his railway time and the local time. Should he ask the beadle, or church officer, when the service begins, he may be answered, "About twal o'clock, wi' half-an-'oor 'aff or on." In Scotland, most of the country people keep their clocks fast even for local time; and it is no unusual thing to see them sitting at the railway station half-an-hour before the train is due. Villages have at last found it inconvenient to have two dials on the village clocks, reading the Greenwich and local times; and the railway time has forced possession. "Scotland before Ireland: nivver!!" was the irate expression of the Irishman from the country who saw in a Belfast watchmaker's window the times marked on dials put beside each other.

So long as the old stage-coach was the quickest means of transit, travellers were not much put about by the differences of the local time on their journey; but express trains and express hurry and express work make a uniform system indispensable. In the latitude of London, a relatively fixed point is got by the rotation of the earth, moving eastward at the rate of 600 miles an hour. A passenger in an express train (which relatively moves at the rate of 60 miles) would—if travelling eastward—be moving at the rate of 660 miles an hour; whereas, if travelling westward, he would be moving at the rate of 540 miles an hour. If local time were kept at the stations, the passenger going east would be under the impression that he had performed the sixty miles in 54 minutes, whereas going westward the time would appear to be 66 minutes. Thus the journey between two places in the same latitude, 450 miles distant, would apparently take an hour-and-a-half longer the one way than the other. Thus it was proved to be highly advantageous to have uniform time in the country. Similarly, in France, Austria, Sweden, Italy, and other countries, the national railway time has been used throughout each country. But in extensive countries like the United States the difficulties were greater. In the States of Canada the complication of the numerous time standards forced an uniform arrangement. Mr. Sandford Fleming, the Engineer of the Pacific Railway, took up the matter so enthusiastically that he first launched the idea of an universal time for the whole world. In 1879 Mr. Fleming read a remarkably fresh paper on the subject before the Canadian Institute, and proposed that the day should begin in Greenwich at noon, and in a place 180° east or west of Greenwich at midnight. The universal day would thus be the Greenwich astronomical day, instead of the Greenwich *civil day*, which was then adopted in Britain.

In 1880 the American Meteorological Society adopted the plan suggested by Professor Pierce five years before. Instead of the 75 different local times then in use at the railway stations in the United States and Canada, five standard times, 4, 5, 6, 7, and 8 hours respectively later than Greenwich, were proposed; and, thanks to the exertions of Mr. W. F. Allen, the secretary of the General Railway Time Convention, this system was adopted in 1883 by 97½ per cent. of the mileage of the American lines. Mr. Fleming's plan was discussed at the Venice Congress in 1881, the Rome Association in 1883, and the Washington Conference in 1884. As the result of these deliberations, the meridian of Greenwich was recommended as the zero of longitude, and the Greenwich civil day (beginning at midnight and reckoning from 0 to 24 hours) was fixed on as the universal day. We are led to expect, therefore, that ere long the uniform time will be adopted over the whole world, it being easy to admit any little difficulties connected with points of law.

Since telegraphic communication is over the length and breadth of the land, it has become absolutely imperative to have a uniform standard of time. It looks so absurd for people in the New World to be reading telegrams several hours before the messages were sent away or before the events therein described took place. Telegraphs take no account of the several uniform standards in the several countries through which they pass. The only question is as to the selection of the universal standard.

Various names have been suggested for the time which it has been decided by the Conference to recommend for general use. Universal time, Cosmic time, Terrestrial time have all been suggested. Mr. Christie thinks that World time is the best. For our part, we prefer the name first proposed by Mr. Fleming—the Universal Day. The Board of Visitors of Greenwich Observatory have, according to the Astronomer-Royal, almost unanimously recommended that, following up the resolution of the Washington Conference, the day in the English "Nautical Almanac" should be arranged, from the year 1891, to begin at Greenwich midnight, instead of Greenwich mid-day—in other words, to make the Greenwich civil day the universal day.

The members of the Conference were of opinion that it would be very advantageous for senders of letters and telegrams to adopt the civil Greenwich day as the universal day, because its commencement falls in the hours of the night throughout Europe, Africa, and Asia. In the United States and Canada the change of date would occur after four o'clock in the afternoon, and in Australia before ten o'clock in the forenoon. In fact, the day would not commence in any important place during ordinary office hours (10 a.m. to 4 p.m.), except in New Zealand. The letters a.m. and p.m. would be omitted in telegrams; this would save the expense of transmission, which is a considerable item in international messages, for in the Western Union Telegraph Company alone no fewer than 150 million letters annually would thus be saved. Besides, the chances of error in transmission of dates would be very much lessened.

It is, however, curious to notice the alteration which the new system will occasion in the ordinary time associations. The hours of sleep, work, and meals will be changed in every place once for all. Instead of continually translating the universal time into the customary local time, men would once for all translate the ordinary time into the universal time. In the Eastern States of North America, business men would indicate midnight by 5 h. U.D. Instead of rising at 8 o'clock a.m. a man would rise at 13 h. U.D. His time for work in the office would be represented by 15 to 21 instead of from 10 a.m. to 4 p.m. He would dine at $23\frac{1}{2}$ instead of half-past 6 p.m. But soon the little inconvenience would pass away, just as one soon gets accustomed to the change of coinage in a foreign country.

It is gratifying to observe that in the United States the railway managers, representing 60,000 miles of railway (98 per cent. of the whole), have agreed to the employment of the universal day. The Americans have prejudices, but they know when to renounce them, and the advantage to them in business by the alteration will compensate for the temporary feeling of having to yield to Great Britain in the fixing of the arrangement.

THE FORMATION AND FUNCTIONS OF STOMATES.—III.

(*Continued from page* 353.)

THE question of the value of transpiration to the plant has given rise to much discussion, but there can be very little doubt that it lies chiefly in the keeping up of constant currents of sap in the woody tissues of plants, carrying with it in solution (all plant-food must be either liquid or gaseous) earth-salts—phosphates, nitrates and sulphates—that these substances may be brought into the leaf at a time when the most elementary form of plant-food, viz., starch, is being formed. As before stated it is in the leaves that the bulk of nutriment is manufactured, and as land-plants are not constructed to obtain their food in its elementary state like submerged aquatic plants, by mere osmosis, the valuable inorganic matters from the soil could never be brought into the leaves in sufficient quantity to properly nourish the plant if it were not for transpiration.

Proof that transpiration is necessary lies in the fact that when it is hindered by growing large plants in a very damp atmosphere they never show a healthy development. Certain species of the cactus and of the stonecrop order (*Crassulaceæ*) exhibit little vigour of growth because devoid of a large area of green surface.

The need for absorption and evaporation of such a considerable quantity of water will be at once seen when it is known that the proportion of dissolved salts to water is 1 to 2,000 or even less, so that in order to obtain one ounce (Troy) of earth-salts a plant has to pass through its system about 166 lbs. of water. The supply of these earth-salts is regulated by the rate of the ascending currents, which in part is influenced by the simple but important physical fact that watery vapour passes off less readily from a saline solution than from pure water, and also probably from its greater density, rendering absorption slower. It is for this reason that plants grown in strongly manured soil transpire less than plants grown in poor soil. The importance of this regulation of the currents lies in the fact when the soil is poor in earth-salts more water is carried up to make up the deficiency; and when the soil is very rich the currents move more slowly so as not to overgorge the plant with more food-materials than it can make use of, a condition which would most likely hinder the internal work of the plant in building up its tissues. In addition to the density of the solution passing up the plant, there are other causes which materially influence transpiration. An instance is given above of the effect of a damp condition of the outer air in checking it, and consequently the slowness of transpiration when other circumstances are favourable is in proportion to the moisture in the atmosphere, but complete stoppage until the atmosphere is quite saturated and its temperature as high as that of the leaves. In spite of the large quantity of water required by land-plants for transpiration it is a notable fact that they grow best in soils which are not always very damp, but which become saturated occasionally. This is borne out by one of the commonest rules in cultivating plants that too much water must not be supplied to the roots for fear of rotting them. It is from May to September, when the soil is in its driest condition, that most transpiration is going on. During the winter it entirely ceases in most plants.

Returning once more to the apparatus by which this important work of transpiration is effected—the stomates—it may be well to conclude with a few particulars relating to their position, form, and size. As has been stated they are found chiefly on the under-surface of leaves, but they are also found on their upper surface, though not in such numbers, as instance the leaf of the white lily, which has from 20,000 to 60,000 per square inch on its lower surface, and only 3,000 per square inch on its upper surface. In plants the leaves of which have both surfaces alike, viz., those which assume a vertical or edgewise position, as the iris, they number the same on either side. In others, such as the water lily, which have floating leaves, they are wholly on the upper side. Up to the present the stomates have been spoken of in connection with leaves and stems, but they are also present on other parts, though in very limited numbers, such as the petals of flowers and even the interior parts of the fruit and seeds, as in the wallflower and walnut, and on underground stems and leaves. They are very seldom to be found on the skin of true roots, on that of etiolated plants, or on those which have been blanched by growing in the dark, or on leaf-ribs. Their infrequency on submerged plants has been mentioned, but when these are grown in air they produce stomata like land-plants. Their shape is generally oval,

but they may be round (common sorrel) or square, or contained in little specially-formed hairy cavities as in the oleander. One of the most remarkable forms of stomates is found in some of the liverworts, where the guard-cells are four or more tiers high, each tier being divided into four or more segments, forming a little chimney-shaped eminence which leads into a rhomboidal chamber between the epidermis and the subjacent tissue. Some of these latter may be seen with a lens. The stomates when expanded vary in size from about the four-thousandth part of an inch in the white lily, in which case the whole stomal apparatus becomes visible with a lens, to 1-500,000th of an inch in *Agapanthus umbellatus*. The advantage arising from such minuteness lies chiefly in the prevention of the entrance of water, dust, and fungus-spores. Yet this extremely slight communication with the air does not prevent the egress and ingress of vapours and gases, whilst, as has been shown, their number is of such magnitude as to make such communication of immense practical value to the plant. It is by the use of such properties as these—properties which are too subtle in their action to allow of ordinary observation—that Nature does the greater part of her most wonderful work, not only in the plant-world, but through all her domain.

Reviews.

The Fundamental Principles of Chemistry. By Robert Galloway, M.R.I.A., F.C.S. London: Longmans. 1888.

Should any of our readers wish to learn what chemistry is as a science, not as an assemblage of facts classified, if classified at all, on a plan resembling that of certain book-owners who think affinity in bindings the only affinity worth considering, we recommend them to buy Professor Galloway's admirable little work. No reading of text-books, great or small, will give them so firm a grasp of the subject as will his method. It is true that his method is not for those who must run while they read, lest they arrive too late at the examination goal, but for the earnest student, for the man who values intellectual honesty and sincerity more highly than outward show. Yet none the less do we, even in this day, when there is so much intellectual show and so little sincerity, urge our readers to take this book in their hands and prepare themselves by its aid to derive real profit from further study in text-book and laboratory.

No one who has not had experience as a teacher of chemistry knows how nearly hopeless it is, under existing regulations and customs, to get into the head of the average student, especially the average medical student, for whom chemistry is a casual incident to be escaped from as rapidly as possible, any understanding of principles, any knowledge of facts sufficiently coherent to stand the test of time. Professor Galloway's book should go far towards helping teachers and students to find a way out of their difficulty, and we wish it the great success it deserves.

The plan adopted necessitates the giving up of a large part of the book to an exposition of the physical properties of matter; but this is really one of its chief recommendations, for the student is often tempted to neglect physics as being dull and difficult, and to lose sight of the fact that he cannot attain a knowledge of chemistry without it. Professor Galloway, by explanation, illustration, and experiment, will bring home to him the laws of heat, and of molecular, and atomic attraction, and the physical properties of gases, liquids, and solids; and then will take him on to chemistry as generally understood, whereby he may learn to think intelligently, and not mechanically and stupidly, of elements and compounds, of acids, bases, and salts.

The examination questions given in each chapter are models of what examination questions should be, for they oblige the pupil to reason from data previously acquired, and do not merely demand on his part a repetition of those data. For instance, Question 348 is, "Explain why coal-gas burns quietly when it issues from a gas-burner, whilst a mixture of air and coal-gas explodes on being lighted?" and another asks the pupil why "a cold plate held above the flame of a candle is bedewed with moisture, and if held in the flame is covered with soot." We wonder, sadly, how many students taught on the usual system could give good answers to these two questions, but we fully believe that those who follow the new system will find them devoid of difficulty.

In view of a second edition of this excellent book, we call attention to the occurrence of a few misprints, notably to the turning upside down of the column of atomic volumes on page 244, which results in making the molecule of hydrogen tetratomic, and that of bromine monatomic.

Proceedings of the Royal Physical Society. Edinburgh. Session CXVI.

We may be permitted to wonder why a body which appears to concern itself principally, if not exclusively with biology, should call itself a "Physical Society."

The address of the President, Mr. J. A. Harvie-Brown, is devoted to the "Isle of May, its Faunal Position and its Bird-Life." This island lies at the mouth of the Frith of Forth, and though only a mile in length, by a quarter of a mile in breadth, it is, like Heligoland off the Mouth of the Elbe, a most important station for observing the great bi-annual migration of birds. Mr. Harvie-Brown points out its importance as a halting-place in the track of the migrants. He briefly summarises some of the facts collected within the last few years by the Migration Committee of the British Association. He then describes the physical geography of the Isle of May; and he treats of the actual bird-life of the island, collating all that had been previously known, and condensing the records of the passing migrants.

Among the principles ascertained is that the line of the autumn migration of land birds across the North Sea is invariably from easterly directions to westerly ones, or from directions south of east to north of west. Birds prefer to travel with a wind from two to four points against their line of flight, because this wind smoothes down their plumage, keeps it close to the body and enables them to use their tails as rudders. They do not willingly migrate with a following wind. Should NW. or W. or even SW. winds prevail upon our eastern coasts, normal migration ensues. With a beam wind birds fly low and steady. With a wind astern they are borne higher, lose their steering power, and are often lost. They have been observed at the height of four miles. In hazy weather they rapidly descend, so as to find their obliterated land-marks, and are often lured to destruction by the glare of lighthouses.

Over the east coast of England birds flow on over the land in unbroken waves, but on the Scottish east coast the waves of migration are compressed, and flow up the depressions.

At the close of his address, the President gives a list of the birds which breed on the Isle of May. Among these was the eider-duck, which we regret to learn has been nearly driven away by persecution.

An interesting paper by Professor Duns on the Water Vole (*Aricola amphibia*) shows that this species often takes up its abode at a considerable distance from the water, making "runs" and throwing up "hills" like the mole. It never appears to prey upon worms or insects, but it does much damage to root-crops, and destroys bushes and seedling apple-trees by gnawing their roots.

The remaining papers in this issue are devoted to various forms of oceanic life, to which now so many zoologists confine themselves—in our opinion, unfortunately—to the neglect of terrestrial life, vertebrate or evertebrate.

Granites and our Granite Industries. By G. F Harris, F.G.S. London: Crosby Lockwood and Son.

This work is both geological and technical, intended mainly for the benefit of quarry-owners and consumers of granite. As a preliminary the author explains the classification of rocks as usually adopted by geologists. He then proceeds to the structure of granite, recommending first a macroscopic and then a microscopic examination. For the latter, a magnifying power of 60 to 100 diameters is sufficient. The necessity for the use of a polarising apparatus is, however, insisted on as necessary for ascertaining the characters of the component minerals of the specimen. The origin of granite is next discussed, and referred to the fusion and cooling of suitable rocks. Next comes a very full account of the granite-quarries of the British Islands. These are found in England in Devon and Cornwall, at Shap Fell in Westmoreland, and at Mountsorrel in Leicestershire. The Channel Islands yields abundance of this rock. The Scottish granite-quarries are chiefly in the counties of Aberdeen, Kirkcudbright, and Argyle, and the islands of Arran and Mull. Smaller deposits are met with in Perth, Banff, Sutherland, and in the Hebrides. Foremost stand the beds in Aberdeenshire, where over a million tons are quarried yearly. Ireland is fairly rich in workable granite. Extensive beds are found in Donegal, Galway, Wicklow, Wexford, Dublin, in the Mourne and the Carlingford Mountains. Most of the granite tracts are close upon the sea. In the Bessbrook quarries near Newry, blocks free from fractures are found of as much as seven yards in length.

As regards blasting in granite-quarries, we are not surprised to learn that where good solid blocks for building purposes are required, gunpowder is the agent preferred. Dynamite and, in like manner, all the so-called "high" explosives shatter the rock too much. The author expresses his surprise that electricity is not more used in blasting, on account of its safety and expedition.

The selection of different qualities of granite for different purposes is an important consideration, and the author points out the conditions which render it unfit for architectural uses. The question is raised why granite is not more commonly used in London. But "buildings made of a durable and beautiful material" will never be common in London until longer building leases—such as are customary in Yorkshire and Lancashire—are introduced.

Mr. Harris's work will be very useful to engineers, architects, and builders, as well as to the quarrying interest.

Schools of Forestry in Germany, with Addenda relative to a desiderated British National School of Forestry. Compiled by John Crombie Brown, LL.D. Edinburgh: Oliver and Boyd.

Not the least desirable of the changes which have come over the human mind during the last half century is the altered manner in which trees are regarded in all civilised countries. In the days of our grandfathers they were viewed as mere cumber-grounds, to be cleared away in any manner or for any purpose. Now we have learnt that, independently of the value of forests for carpentery purposes, they have a high climatological and sanitary importance. Certain far-seeing men long ago sought to convince the public of the folly of a reckless destruction of forests. Colbert even gave utterance to the assertion that "France will perish through lack of wood." In 1721 Réaumur, in a memoir presented to the Academy of Sciences, declared that: "The interests of the State demand at the least that the quantity of wood should not be diminished while the consumption is being increased." These warnings were, for the time, unheeded. But now France and Spain feel it necessary to incur heavy expense in replanting their denuded hill-sides, and find it pay. The same work, with the same results, is being carried on in the north-west of India. The Americans are beginning to admit that if one-fourth of a region is devoted to forests the remaining three-fourths will yield more than would the whole if recklessly laid bare. From the prospectus of some other works by the same author on kindred subjects we learn that the damage occasioned by torrents in Cape Colony and Natal must amount to hundreds of thousands sterling yearly. At the close of 1874 the havoc occasioned in public works alone is estimated at £350,000! But restrictions on felling trees and replanting the mountain-sides will be labour in vain, unless the goats are disestablished.

The author's account of the schools of forestry in Germany is exceedingly interesting as affording proof of the great importance attached in that country to the conservation of forests. We are far from holding that these institutions ought to be closely followed in schools of forestry for the United Kingdom, for India, and the colonies. It seems to us that there is too much time and attention devoted to abstract studies, such as the higher mathematics, and even forest-laws. We make this remark from the conviction that the class of minds best fitted for the close and accurate observation of vegetable and animal life will either be repelled or impaired by being made to take up such uncongenial studies.

One of our national mistakes is that candidates for the Indian forest-service, after passing certain examinations in England, go, under an arrangement with the French Government, to be trained in the forest-schools of France. We hold that their training should be effected in India, and not in a country where the trees to be conserved, their animal and vegetable enemies, and the climate and seasonal conditions are totally different.

Dr. Brown is recognised throughout Europe as an authority on forestry, and his works will be found most instructive reading.

Abstracts of Papers, Lectures, etc.

ROYAL INSTITUTION.

On March 22nd the Rev. Dr. Dallinger delivered his third and last lecture on the "Least and Simplest Forms of Life." The lecturer, referring to the enormous rapidity with which the generations of these micro-organisms multiply, said that they had seemed to him likely to serve as useful subjects for investigating the effects of a slow progressive change of environment upon organisms. In this idea he was encouraged by letters which he received from Charles Darwin. Some remarkable results had been previously obtained by subjecting Entomostraca to a water becoming very slowly more and more impregnated with common salt. In this manner such creatures have been modified not merely into distinct species, but even into a new genus. On considering the agent most suited to the resources of a private biological laboratory, he pitched upon heat, and accordingly he exposed water rich in putrescent matter and swarming with microbia, such as had been described in the former lectures, to a very gradual increase of temperature, beginning with 60°—70° Fahr., which seems to be the point at which these creatures multiply most rapidly. An apparatus was devised and arranged by means of which jars containing the liquid and its inhabitants could be kept automatically within $\frac{1}{4}$ degree Fahr. of any desired temperature for any length of time, but could, if required, be made gradually warmer. The stage of the microscope was so arranged that drops of liquid taken out for examination could be kept at the same temperature as that in the jars.

The experiments proved very tedious and delicate. Sometimes weeks had to be spent in raising the temperature a single degree, but by care and patience numbers of the species under observation were brought not merely to live, but to prosper and multiply, at 158° Fahr. The effects of increasing heat were not regularly progressive. There occurred *critical points* at which multitudes perished and the remainder became languid. But on allowing the heat to remain stationary for a time, the survivors recovered, multiplied as before, and did not seem in the least incommoded by a rise of a few degrees more. Then came another critical point, which had to be tided over with the same precautions.

No permanent structural change was recognised, but a decided physiological modification had evidently been effected, since if a few of the microbia which were brisk and lively at 158° Fahr. were dropped into water at 60°—70°, their initial temperature, they were instantly killed. In the same manner if any microbia were taken from water at 60°—70°, and plunged into water at 158° Fahr., they perished at once.

Dr. Dallinger's experiments were brought to a premature close by an accident to his apparatus, but he hopes to resume them with improved apparatus.

ROYAL SCOTTISH SOCIETY OF ARTS.

Among the reports submitted by a Committee on papers previously communicated on April 9th, was one with reference to Mr. Hart Robinson's writing telegraph. For the first time, it was stated, in the history of telegraphy, a sender was enabled by the means of this invention (which has already been described) to transmit to a distant station a message in handwriting, the *fac-simile* of what was sent, with nearly the same speed as that of ordinary writing. This writing telegraph marked a new departure in the history of practical telegraphy.

Mr. D. A. Cormack read a paper on the "Protection of Propellers from Corrosion," in which he advocated the use of his "Vindex" as a safe, sure, and cheap protector. The invention, it appeared, is founded upon the knowledge of the different degrees of affinity of oxygen for various metals, and for the same metal in different degrees when its parts differ in their chemical components. When immersed in a favourable medium, these act and react upon each other in such a way as to cause rapid deterioration in the electro-positive portions. Brass being negative to the iron and steel in shafts and propellers, the latter rapidly corrode unless provided with some electro-positive absorbent in contact with themselves. This was provided in the "Vindex," which might be employed in the form of nuts for blades, or of caps for tail ends. The metal used was zinc, or a compound of which the basis was zinc, the tenacity of which, though low, had been proved, when used in the form of blade-nuts, to be fully equal to the tensile strength of the stud. Further, only a small proportion of the brass nuts required to be replaced with zinc. In the case of the cap over the tail nut, when inconvenient to take it off in order to renew the zinc, this might be done in place by means of a cover provided with a gate for the reception of the liquid metal, temporarily set upon the space to be filled. In cases where the cast-iron cap loaded with zinc could not be conveniently applied, a zinc cap might be cast, and secured over the tail nut by a single bolt screwed into the end of the shaft. The apparatus was shown to the meeting, and the invention was favourably commented upon.

ROYAL INSTITUTION OF BRITISH ARCHITECTS.

On April 9th, Mr. Vivian B. Lewes, F.I.C., F.C.S., Royal Naval College, read a paper upon "Illumination and Ventilation," and the author said all our existing illuminants resemble each other in composition; the light-giving waxes, fats, oils, and gases, all depending for their lighting and heating effects upon the elements carbon and hydrogen, which, by a selective process of combustion, emit light, at the same time producing as products of their complete combustion carbonic acid gas and water vapour, both of which have, when present in quantity in the air we breathe, a very deleterious effect upon our health.

The unit of illuminating power as adopted in England is a "sperm" candle of the size known as "sixes," which, when burning under normal conditions, consumes 120 grains of sperm per hour, and emits an amount of light known as "one candle power." Adopting this standard and experimentally determining the amount of material used, in the best form of lamp or burner for its consumption, we have a means by which we can compare the lighting power and the vitiating effect which our illuminants give.

The amount of light to be obtained from a given volume of coal gas depends upon the form of burner used, whilst the vitiating effect upon the air is also expressed in the number of adults who would exhale the same amount of carbonic acid gas during respiration. The gas used for the tests was that supplied to the City, which, during the past six months, has had an average illuminating power known as 16·5 candles. All volumes

of gases are calculated at normal temperature and pressure.

Amount of Oxygen removed from the air, and Carbonic Acid Gas and Water Vapour generated to give an illumination equal to 32 candle power. (The amount of light required in a room 16 by 12 by 10.)

Illuminant.	Quantity of materials used.	Oxygen removed.	Products of combustion.		
			Water vapour.	Carbonic acid.	Adults
Sperm Candles	3840 grains	19·27 c. f.	13·12 c. f.	13·12 c. f.	21·8
Paraffin Oil	1984 grains	12·48 c. f.	7·04 c. f.	8·96 c. f.	14·9
Gas (London)—					
Burners :					
Batswing	11 c. f.	13·06 c. f.	14·72 c. f.	5·76 c. f.	9·6
Sugg's London Argand	9·7 c. f.	11·52 c. f.	12·30 c. f.	5·12 c. f.	8·5
Welsback (incandescent)	5·3 c. f.	6·30 c. f.	7·10 c. f.	2·75 c. f.	4·6
Wenham (regenerative)	3·2 c. f.	3·68 c. f.	4·16 c. f.	1·60 c. f.	2·6

From these data it appears that according to the rules laid down in sanitary science, by which the degree of vitiation of the air in any confined space is measured by the amount of oxygen removed and carbonic acid formed, candles are the worst offenders against health and comfort, and gas the least, an assumption which practical experience does not bear out, the feeling of oppression being distinctly less in a room lighted by candles or oil than in one lighted by any of the older forms of gas-burner. The explanation of this is that when we use candles or lamps we are contented with a smaller and more local illumination than when gas is used; also more water vapour is given off during the combustion of gas; and this absorbs radiant heat, and heats the atmosphere, whilst the air being charged with moisture, evaporation from the skin is checked.

Still more important reasons are that, even in the highly-purified London gas, small quantities of impurities are present which give products of combustion more deleterious to health than carbonic acid; whilst bad forms of burners cause incomplete combustion, giving rise to carbonic oxide, which, even in small traces, is highly poisonous; and finally all the products of combustion, being at a higher temperature than the air of the room, rise to the ceiling, and collect there, and the exhalations from respiration, and the skin being at a lower temperature, cannot rise through them, so that the ceiling is practically lowered to the level of the gas-burners.

All these considerations bring us to the conviction that for the health of ourselves and our families we must have adequate ventilation specially provided to remove the products of combustion given off by illuminants from our dwelling-rooms.

If we use candles or oil-lamps, all we can do is to secure the ventilation of the room by the ordinary methods, as the conditions under which these sources of light are employed prevent their being used as a ventilating power; but with gas this is not the case. Attempts have been made from time to time to provide special ventilation and the removal of the products of combustion; but, with the exception of "Sun-burners" for large halls and places of public entertainment, none have met with any degree of success, owing to the unsightly tubes needed to convey away the heated gases; but with the new era of regenerative gas-lamps this trouble disappears, and gas can now be made not only the best and most convenient means of illumination, but also a powerful engine for ventilation.

Of the various forms of regenerative lamps now in the market, the "Wenham" is the one most suitable for this purpose, as the shortness of chimney required and compactness of the regenerative portions of the lamp, enable it to be fixed with the burner within fifteen inches of the ceiling, and sufficiently far above the head to prevent any sensation of radiant heat from it, whilst the air supply to the flame is so arranged as to be undisturbed by the up-draught created in the flue attached to the lamp. In order to convert the lamp into an efficient ventilating agent, it is set in an ornamental metal box, which fits into the ceiling space, and has its lower portion, with the lamp attached, projecting downwards into the room; and this part is provided with openings into the room. The upper portion of the box in the ceiling space has a flat rectangular flue attached to it, which passes alongside the joists, and is led into the flue of the room illuminated by the lamp, or into a special flue fitted in the chimney stack. Under these conditions a No. 4 Wenham lamp, consuming from 20 to 24 cubic feet of gas per hour gave, as an average of illuminating power from 120 candles in a horizontal plane to 280 in a vertical, whilst a current was created in a flue with a velocity of 12·5 feet per second, and the area of the tube being 6 inches by 4 inches, this was equal to 7,498 cubic feet per hour. The temperature of the gases in the flue 4 inches from burner was 276° F., but the air in the room was at 60° F.; and reducing the volume to this temperature, and deducting the air used by the lamp, we have 5,160 cubic feet of air over and above that required by the lamp, removed from the upper part of the room to be replaced by cool fresh air, whilst none of the products of combustion are allowed to find their way into the room. With a No. 2 lamp, burning 10 cubic feet per hour, 2,000 cubic feet of air per hour was withdrawn from the room.

In order to fully realise the importance of these results as bearing upon ventilation, one must remember that nearly all the impurities in the air emanate either from the body or from the combustibles used, and are therefore, at a higher temperature than the normal air of the room, with the result that, being expanded by heat, they are lighter and rise to the ceiling, so that the air withdrawn by the burner is not the ordinary air of the room, but the foulest air in the room.

In order to test the safety of the flues passing through the ceiling space a number of experiments were made as to temperatures of the products of combustion and the exterior surface of the flues.

The metal box containing the lamp is double-jacketed with $1\frac{1}{2}$ inches of "silicate wool," which, being fire-proof and a non-conductor of heat, prevents the escape of heat anywhere near the lamp, the highest temperature ever reached being 90° F. The flue which conveys the mixed products of combustion and air from the lamp casing to the chimney were jacketed with $\frac{3}{4}$ inch of silicate wool, in the hottest part rarely reaches 100° F., whilst if the flue be packed round with loose silicate wool, kept in position by a layer of loose slates placed on it, no heat at all escapes.

As regards the heating effects of regenerative burners on the air of a room, the kind of heat given out is almost entirely radiant heat, which does not heat the air directly, but heats the walls and furniture in the room, and these in turn heat the air, whilst in the old forms of burner the air is rapidly heated by convection, radiation playing but a small part in the heating of the room. In the first instance, you have warm walls and furniture with cool air, which are undoubtedly the conditions best suited for health and comfort; whilst, in the second case, you have warm vitiated air with cold walls: a state of affairs which lead to chills and discomfort to the system.

The amount of radiant heat given out by a regenerative burner is considerable close to the lamp, but rapidly diminishes as the distance from it increases, so that five feet from the burner of the lamp it is hardly perceptible, and only amounts to about 2-10ths of a degree; and this may be entirely done away with by suspending a sheet of thin plate glass just below the lamp, which, while cutting off the heat-rays, will allow 88 per cent. of the light to pass through.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting on Tuesday, the 10th of April, the President, Mr. Bruce, being in the chair, the paper read was on "Compressed Oil-Gas and its Applications," by Mr. Arthur Ayres, M.Inst.,C.E.

In considering this system of illumination, its applicability to buoys, isolated beacons, lighthouses, and railway carriages, etc., the author treated it under the primary heads of mode of manufacture, illuminating properties, cost, storage, and transit, and in doing so he referred to the early history of oil-gas and the patents taken out from time to time in connection with the system. It was stated that in 1825 Faraday contributed a paper to the Royal Society "On New Compounds of Carbon and Hydrogen, and on certain other Products obtained during the Decomposition of Oil by Heat." That communication, however, dealt with the chemistry of oil-gas. It was mentioned in that paper that 1,000 cubic feet of good gas yielded nearly one gallon of hydro-carbon. The gas from which the hydro-carbon was obtained was manufactured by the Portable Gas Company, and was compressed to thirty atmospheres. It was drawn from a gasholder and passed over water into a large and strong receiver, and from it into portable vessels, the principal condensation taking place in the receiver. The oil-gas manufactured by the Portable Gas Company was not distilled from shale oil or petroleum, but from other oils and fatty substances, mineral or vegetable. Between the years 1792 and 1883 numerous ingenious patents were taken out for manufacturing and compressing oil-gas for lighting and heating purposes. Oil- or hydro-carbon gas was the product of heavy petroleum or shale oil once distilled. It had a specific gravity of about ·840, and flashed at about 220° Fahrenheit. In detailing the process of the manufacture of oil-gas, the author described the works erected at the South Foreland by Pintsch's Patent Lighting Company (Limited). The illuminating intensity of oil-gas might be taken at from forty to fifty candles when burned in a London standard argand burner, with a consumption of five cubic feet per hour, under a pressure of 0·5 inch of water. Until the adoption of oil-gas for their illumination, buoys and isolated beacons were only useful for the purposes of navigation by day; but they were now equally so by night (in clear weather), enabling vessels to navigate with safety intricate channels, which hitherto could not have been attempted except at considerable risk. Gas-buoys, as at present used by the Honourable Corporation of Trinity House, were constructed of best mild steel; they were spherical, nine feet in diameter, and surmounted by a light wrought-iron superstructure, carrying a lantern enclosing the illuminating apparatus. The total weight of one of these buoys complete was about 80 cwt., the weight of the buoy being 78¾ cwt., and that of the illuminating apparatus 1¼ cwt. The buoys were usually charged to a pressure of five or six atmospheres, or from 75 to 90 lbs. pressure per square inch. The gas was contained in the spherical portion of the buoy, the capacity of which was about 382 cubic feet, and was consumed at the rate of three-quarters of a cubic foot per hour, burning night and day continuously. When fully charged to five atmospheres, and burning at the above rate of consumption, the light would be maintained for 106 nights and days. The intensity of the light was from seventeen to twenty candles through the lens. There were now 214 buoys, lightships, beacons, and other lights in use in various countries on Pintsch's system.

The author next dealt with the application of compressed oil-gas to the lighting of railway carriages, which he stated was one of growing importance. It was probably first tried in the year 1871 with satisfactory results, in Germany, on the Lower Silesian Railway, and in England in 1878 on the St. John's Wood trains of the Metropolitan Railway, with equally satisfactory results. The Great Eastern Railway Company was the next to adopt it, the Metropolitan Railway Company definitively adopted it for the whole of its rolling-stock a few weeks later, and other Companies quickly followed suit. The systems chosen were those of Messrs. Pintch and Messrs. Pope and Sons, which differed but little from each other. Some trials were also made of Messrs. Bower's system on the Great Northern Railway. The gasholders were attached either to the roofs or to the under-framing of the carriages, and were charged to a pressure of from six to eight atmospheres. The gas was conveyed to the roof-lamps by pipes from the gasholders, passing through a contrivance for regulating the pressure at the burners, one such regulator being attached to each carriage. There were now 23,499 carriages so illuminated on Pintsch's system, and 2,791 on Pope's system. In the double journey between Euston and Aberdeen the cost of the ordinary oil system was 8½ times more than oil-gas.

MODERN PHOTOGRAPHIC ENGRAVING AND PRINTING.—III.

A Paper by Mr. George S. Waterlow, read at the Conference of the Camera Club.

(Continued from page 357.)

We now come to collotype printing, and it is perhaps of all methods of photo-mechanical printing the one which lends itself to the greatest variety of effects; every one of the previously-mentioned processes can be closely imitated by it.

It is, above all others, the best process for facsimile reproductions in large numbers, reproducing an engraving, a fine drawing, a wash drawing, a photograph of nature, or from life, all with equal facility. The principle of the process is, as in the others, founded upon the altered nature of gelatine with bichromate of potash after exposure to light, but in this case differing from those mentioned previously in the fact that the printing begins and ends with the original gelatine surface. It is very simple—a thick sheet of plate glass (sometimes metal is used) generally, but not necessarily, ground on the surface, is first coated with a substratum containing silicate of soda and albumen (15 to 1) which has a great holding power; when this coating is dry, the surface is recoated with a solution of gelatine and bichromate of potash, and dried quickly in a hot dark room, or chest. The plate is now ready for exposure under a negative (either a collodion

or ordinary dry plate), which must be reversed. After proper exposure, according to the density of the negative, the plate is thoroughly washed in water and dried; only a faint trace of the image or picture can be seen on the plate at this stage. It is now placed in a printing press (generally lithographic) damped with water, and a leather roller charged with printing ink passed carefully over the plate.

Now is seen most clearly the curious and interesting action of light upon the prepared gelatine—the gelatinous surface receives the printing ink from the roller in exact proportion to the amount of light that has passed through the different parts of the negative, *i.e.*, where there are blacks in the picture the plate inks up solid; where white, it will take no ink at all; and where half-tones exist, it takes ink in the same gradation all over the plate. It only remains now for the printer to lay a sheet of printing-paper, smooth or rough, upon the plate and to pass it through the press. The result will be a Collotype print. One can also print excellent copies of any subject upon calico, linen, satin, and other fabrics. A good plate will give 400 to 500 copies, sometimes 1,000. Ink of any colour may be used and any paper. The prints may be varnished and mounted like ordinary photographs, or they can be printed on paper with white margins, like an engraving.

With these few remarks I conclude my paper. These arts, but briefly described, which have, as I have stated, numerous allies, open up a field for further advancement beyond the limits of ordinary speculation.

They already have created an industry which capital has not been slow to encourage, and which gives employment to thousands where only twenty years ago but a few were earning by it a livelihood.

Through these means our homes are enriched with true copies of works of art, and at a low cost; even the poor man has within his reach illustrations with which to cover the walls and educate his taste. And who shall gainsay that through photography future generations may receive the greater blessings that accrue to human life by the mind being raised to higher and better aims through the refining influence of art and knowledge?

From the *Camera* and its allied arts, cheap and faithful pictures are placed within our reach, of art in its highest forms, of the beauties and the wonders of the world we live in, of our mountains, rivers, seas, and lakes, our cities in countries of every clime. Nature in all its grandeur, life in all its detail, is spread at our feet.

ENEMIES OF TREES.

WE see sometimes, says M. de Kerwan in *Cosmos*, in autumn, in winter, and even in summer, young shoots or ends of branches dropped by trees, such as pines and firs, etc.

In certain cases this fact is a trifling accident which does not involve any serious consequences. In others it is the symptom of a serious disaster which may extend to large masses, even to entire forests. Trees, both the soft-leaved and the conifers—*needlewood*, as the latter are aptly called in Germany—in addition to the enemies common to all plants, have their special foes, exceedingly formidable, the presence of which should be early detected in order that they may be promptly combatted.

It may happen that rodents, especially squirrels, are to blame, and it is easy to ascertain this point by examining the young shoots or sprays which have fallen off. If the fracture of the twig presents a more or less distinct section without any aperture indicating the beginning or the end of a minute tunnel, the shoot has been cut off by the teeth of some rodent, or perhaps it may have been detached by the beak of a rook or crow. In this case, which is the least unfavourable, the evil is merely transitory. Trees thus attacked suffer merely the loss of a small portion of their leaves, and in the following spring the injury is quickly repaired.

But if the base of the young shoots where broken off presents the aperture of an excavated gallery, whether in the woody tissue itself or between the wood and the bark, the evil is more serious, and may be hard to deal with. It may be evidence that the trees thus attacked contain in their branches, or even in their stems, colonies of minute Coleoptera, of the genera *Bostrichus*, *Hylesinus* and *Scolytus*. Certain species of these small beetles penetrate into the wood in spring, and excavate there galleries in which the females deposit a great number of eggs. From these there quickly emerge small larvæ, which continue the ravages of their mothers. When they have in turn arrived at maturity, each digs out a small round hole of the diameter of its body, carrying it often to the very tip of the shoot. This destructive work is continued until the winter. The insect—say *Hylesinus piniperda*—then leaves the young shoots, which show outwardly nothing of the ruin within, and hides itself at the foot of the trees, in the moss, in the grass, or sometimes in the trunk of the tree. As the winter comes on the perforated shoots gradually wither, and fall to the earth under the weight of the frost or snow, or from the strain of the wind.

We have thus described the operations of the *Hylesinus* of the pine-tree. But the family is rich in species. There is a *Hylesinus niger*, *Polygraphus pubescens*, *Tomicus micrographus*, *Monographus* and *Typographus*, considered by some as the very worst, *Scolytus destructor*, and several others.

In different forms, and at different seasons of the year, these pests all run their galleries, either in the wood or between the wood and the bark. On stripping off the bark from a decaying tree these galleries may often be seen presenting a resemblance to written or printed characters.

Some begin their attacks in the branches, and these are the least dangerous, because as soon as their presence is detected, the branches may be cut off below the point of attack and carefully burnt, thus destroying the entire colony. Others penetrate at first into the stem, and only appear in the branches after they have ravaged the entire tree. The damage is then beyond recovery, and all that can be done is to cut down the infected trees and burn them, wood, bark, and twigs.

The soil should be carefully raked around the infected trees, and all the rubbish collected should be burnt.

BLACK SNOW.—M. Pezons, the curé of Saint Bandile, writes to *Cosmos* that the country was already covered with a deep layer of ordinary white snow, when a cold west wind brought black snow in the form of small crystals. This new layer, though very slight, gave the snow a very distinct deep grey colour. The icicles adhering to the trees were also blackish. This phenomenon was observed over the space of about five square kilometres (three square miles).

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

LUMINOUS PHENOMENON AT SEA.

I have recently read an account of a strange luminous phenomenon alleged to have been seen somewhere in the Atlantic at about 100 miles to the south of the equator. The master and mate of a Spanish vessel on its way from South America to England saw right ahead a shaft or pillar of greenish light, as if standing on the water. The steamer took, at full speed, seven minutes in passing through this column, and during this time she was illuminated with a vivid green radiance, about equal in intensity to the light of a waning moon. The light is described as being sharply defined and stationary, the sea being calm and the sky overcast. The published accounts make no mention of any electrical phenomena. I should be much obliged if you or any of your readers can give me any information as to the probable nature of so strange a phenomenon. The latitude proves that it cannot have been any modification of the Aurora. A CORNISH MAN.

SCREECHING WATER-BEETLE.

The insect described by your correspondent "F. P. P." in SCIENTIFIC NEWS for March 16th is most probably *dytiscus marginalis*. At least this species does squeak if taken out of the water, and it agrees fairly well with "F. P. P.'s" description. J. W. S.

SCIENCE AND ART.

A contemporary of yours makes the following attempt to confuse science and art. He says:—"The line of separation between science and art is more apparent than real. A student who draws a carved mantelpiece at a distance of twelve feet is an art student: the youth who walks up to it and draws it by measurement is a science student. The student who critically examines the skeleton in the art school, preparatory to drawing from the life, is an art student: but he who studies it as the framework of the living form, with bones, muscles, and tissues, and whose powers of drawing at best will result only in a feeble sketch, is a student in the science subject of physiology."

I would say that science has no concern with "carved mantelpieces." Further, the man who studies skeletons is a morphologist, not a physiologist. He does not necessarily make a "feeble sketch," or any kind of sketch of his specimens. If he does so it is merely something collateral and incidental, not his primary object. It is a pity that your contemporary has not met with the distinctive characters of science and art as laid down by Mr. Crookes, F.R.S. "Science," he writes, "sees phenomena, records them, traces their laws, and questions nature, her sole object being truth. Where completely successful she attains prevision. Art, on the contrary, seeks to produce, to modify, or to destroy. Her sphere is action. She aims at power and enjoyment, and when completely successful she creates."

ITHURIEL.

FURCULA OF FOWLS.

May I be permitted to call the attention of your readers to the peculiarity of the furculum or anchylosed clavicles of the common fowl and our game birds, namely, that the left clavicle is nearly always more bent, rather thicker, and also thicker at the base, or point of anchylosis, than the right clavicle. I forward you some furcula of the common fowl, in which you will see the peculiarity to which I refer—and upon which works on comparative anatomy are silent—well pronounced. I can find no trace of this peculiarity in the furcula of water birds, plover, woodcock, or snipe.—Yours faithfully, JOSEPH P. NUNN.

Royston.

[The specimens sent seem to confirm the writer's statements.—EDITOR *S. N.*]

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

LAWN TRIMMER.—An apparatus for cutting the edges of lawns has been patented by Mr. J. Sunley, Ben Rhydding, near Leeds. The frame of the machine is similar to that of a lawn mower: the spindle carries at one end a star cutter working against a fixed knife. A series of rotary blades or deliverers are placed outside the star cutter, and carry the cut grass into the receptacle. The spindle is driven from the main axle by gearing.

A PROJECTILE.—Messrs. A. E. Barthel and J. C. J. Möller, both of Germany, have patented a projectile. According to this invention the projectiles are so made that the tip has the form of a hemisphere, the remaining portion of the forward part being cylindrical, and serving to guide the projectile in the barrel, whilst the rear part is of conical form and of less diameter than the foremost part of the projectile, and serves to guide it in its flight. The projectiles are so made that their length is from $1\frac{1}{2}$ to 3 times the diameter of the bore, and in consequence of this construction the double curved trajectory is avoided.

CRICKET TENNIS.—A game of cricket tennis has been patented by Mr. W. C. Owston, of Wentbridge Lodge, Pontefract. The invention consists of a game of tennis played in sides of one or two on each side, and with one ball, and instead of the ball having to be sent over a net it has to be sent under a cord in a fixed central goal in suitable frames open at the fronts, towards each court line, but closed at the ends by nets. Should the player send the ball under the cords through the central goal and over the court line, it counts to the player, but should he fail it counts to the opposite side, who return it before it stops, through the goal.

SPRAY GENERATOR FOR COLLIERIES.—A method of damping dust in collieries has been patented by Messrs. H. W. Martin and J. Turnbull, both of Dowlais, Glamorgan. According to this invention the agents employed are air in a compressed state, and water, which are conducted as required in separate conduits, and are drawn off therefrom at will through branch pipes situated at the places of application, and are ultimately discharged together at such places through a terminal nozzle, which causes the water issuing thereat to assume the character of a fine spray. This spray is diffused by the air currents, and damps the air and dust with which it comes into contact.

AN OIL LAMP.—Mr. G. R. Postlethwaite, Birmingham, has patented an oil lamp. The object of the invention is to prevent the conduction of heat to the reservoir by the metallic parts adjacent to the flame, and so lessen the consequent danger of explosion. Two slots are made in the burner cone below the ends of the slit, the slots being provided with hoods to deflect the ascending air current outwards between the burner cone and the

chimney. To obviate the diminution in the quantity of air supplied to the flame occasioned by this modification of the burner cone, two series of perforations are made in the rim at right angles to the positions of the slots Air entering these perforations ascends the sides of the flat wick tubes to feed the flame.

ELECTRICAL GAS LIGHTER.—Mr. T. P. Hewitt, Eccleston Park, Preston, has patented an electrical gas lighter. An outer fixed cylindrical case is provided, and an inner revolving cylinder, both made of ebonite, in which may be cut air spaces, to form the dialectric. The top and bottom of the outer cylindrical case is preferably closed by metal caps, which also serve as pivots in which the spindle of the inner cylinder rotates. Through the outer cylinder above or below the end of the inner cylinder is placed a push which, on being pressed in, causes the inner cylinder to rotate at a high speed by the force given to the pusher. To produce the spark for lighting gas, there is fixed to an ebonite disc fitting in the outer cylinder light contact springs, in such a manner that when the inner cylinder is revolved, a contact is made with the contact pieces provided on the ends or sides of the inner cylinder.

SUBMARINE VESSEL.—Messrs. G. Poore and W. C. Storey, both of London, have patented a submarine vessel. For maintaining it in a horizontal position there is arranged at or near each end of the vessel, a chamber containing a piston, plunger, or diaphragm, one side of which is in free communication with the water in which the vessel is submerged. The pistons, etc., are connected with each other and with a valve by any suitable means. The arrangement is such that when one end of the vessel is submerged lower than the other, the difference of water pressure on the pistons, etc., due to the difference in depth of their immersion, will automatically operate one or other of the pistons and the connected valve, and cause fluid under pressure to pass towards one or other end of the vessel, and restore it to a horizontal position.

ICE-MAKING MACHINE.—Mr. E. de Stoppani, of Paris, has patented an ice-making machine. The object of this invention is to utilise the waste steam which comes from the engine in the production of the best transparent ice. The steam is first caused to pass into a cylindrical casing, in which are a number of concentric cylindrical partitions, each of which has a number of very narrow vertical slits all round, of a length equal to about one-half the height of the cylinder, these slits being alternately in the bottom part of the one cylinder and in the top part of the next; and they are also so arranged that the slits of one cylinder are in line with the spaces between the slits of the next. Thus the exhaust steam entering the outer casing is caused to pass in a very tortuous manner and finely divided condition through the successive cylindrical partitions, in order to arrive at the central discharge tube, whence it passes to the condenser, and by this means the particles of oil carried along with the steam will be separated therefrom, and collect, together with some water of condensation, at the bottom of the apparatus, whence it is drawn off by a pump, the oil being used over again for lubricating the engine.

ANNOUNCEMENTS.

SEISMOLOGY IN PARIS.—We learn that, as a result of the earthquake shocks recently felt in the south of France, it has been decided to give a course of lectures on Seismology, or the science of earthquakes, at the Sorbonne. This science is most actively studied in Japan, but instruction is also given in Italy and Switzerland.

MANCHESTER GEOLOGICAL SOCIETY.—The Honorary Secretaries will be happy to receive in writing, not later than the 25th April, communications on the subject of "Mine Rents and Royalties," in order that the same, if approved of, may be read at the meeting on the 4th May. Such communications to be kept strictly within the limits of the objects of the Society.

EGYPTIAN EXPLORATION FUND.—A Special General Meeting of the Egypt Exploration Fund, to confirm the Articles of Association, will be held in London on the 9th May.

THE HOSPITALS ASSOCIATION.—The next evening meeting of the Hospitals Association will be held in the Governor's Hall of St. Thomas's Hospital, Albert Embankment, S.E., on Wednesday, 25th April, at 8 p.m. The President of the Association (Dr. J. S. Bristowe) will preside, and a paper will be read by Mr. W. Burdett-Coutts, M.P., on "Contributions by Patients in Relation to the Financial Condition of London Hospitals." Cards of admission can be obtained on application from Mr. Howard J. Collins, Secretary, the Hospitals Association, Norfolk House, Norfolk-street, W.C.

LECTURES ON BOTANY.—Mr. J. G. Baker, F.R.S., F.L.S., will deliver a course of twelve lectures on Botany at the Garden of the Apothecaries' Society, Chelsea, on Saturdays during May, June, and July, at 3 p.m. Tickets can be obtained from the Bedell of the Society.

DIARY FOR NEXT WEEK.

Monday, April 23.—Society of Arts, Cantor Lecture, at 8 p.m.—*Milk Supply, and Butter and Cheese Making;* by Mr. Richard Bannister.
Society of Chemical Industry (London Section), at 8 p.m.—*Notes of the Manufacture of Chlorine, with Special Reference to the Use of Magnesia in that Process, and its Economy;* by Mr. C. T. Kingzett. *Further Notes on M. Hermite's Process for Electrolytic Bleaching;* by Messrs. Cross and Bevan.
Bradford Naturalists' Society, at 7.30 p.m. *The Genus Arion (Slugs);* by Mr. W. D. Roebuck.
Aristotelian Society, at 8 p.m.—*Conscience Theories;* by Mr. Pasco Daphne.

Tuesday, April 24.—Society of Arts (Applied Arts Section) at 8 p.m.—*Craftsman and Manufacturer,* by Mr. Lewis Foreman Day.
Royal Institution, at 3 p.m.—*John Ruskin,* by Dr. C. Waldstein.
Parkes Museum, at 8 p.m.—*Sanitary Appliances;* by Professor W. H. Corfield.
Institution of Civil Engineers, at 8 p.m.—*The Tay Viaduct, Dundee;* by Mr. Peter C. Barlow, B.A.

Wednesday, April 25.—Society of Arts, at 8 p.m.—*The Physical Culture of Women;* by Miss Chreiman.
Civil and Mechanical Engineers' Society, at 7 p.m.—*On Railways for Rural and Under-developed Districts;* by Mr. James B. Walton.
Royal United Service Institute, at 3 p.m.—*The Position of the Torpedo in Naval Warfare;* by Captain Hubert H. Grenfell, R.N.
Cardiff Amateur Photographic Society.—*Enlarging;* by Mr. W. Kitchin.

Thursday, April 26.—Royal Institution, at 3 p.m.—*The Chemical Arts;* by Professor Dewar, F.R.S.
Society of Telegraph Engineers and Elec-

tricians, at 8 p.m.—*On the Risks of Fire, Incidental to Electric Lighting*; by Mr. W. H. Preece.

Camera Club, at 8 p.m.—*Platinotype Printing*; by Mr. Willis.

Friday, April 27.—Royal United Service Institute, at 3 p.m.—*The Mechanism of the Counter Attack*; by Major Walter W. M. Smith, R.A.

Royal Institution, at 9 p.m.—*Electrical Influence Machines*; by Mr. J. Wimshurst.

Parkes Museum, at 8 p.m.—*Scavenging, Disposal of Refuse and Sewage*; by Mr. H. Percy Boulnois.

Saturday, April 28.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner*; by Mr. C. Ambuster.

Physical Society, at 3 p.m.—*On Electromotive Force by Contact*; by Mr. C. V. Burton. *On a Theory Concerning the Sudden Loss of Magnetic Properties of Iron and Nickel*; by Mr. H. Tomlinson. *Note on the Graphic Treatment of the Lamont Frolich Formula for Induced Magnetism. Note on the Conditions of Self-excitement in a Dynamo Machine. Note on the Conditions of self-regulation in a Constant Potentional Dynamo Machine*; by Professor S. P. Thompson.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

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Patents.—Nine months' protection, 50s.; patent completed from £6 10s.—P. M. ROGERS, 21, Finsbury Pavement.

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New Dark Room Electric Lamp, ruby, orange, white alternately, regulator to battery, 17s. 6d.—MEDLAND, Borough, London.

S. Bottone, Carshalton, supplies, post free, the following books:— "The Dynamo," 2s. 6d.; "Electrical Instrument Making," 3s.

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"Inventors' and Manufacturers' Patent and Trade Mark Pocket Guide," by G. C. MARKS, C.E., 13, Temple Street, Birmingham. Four stamps.

"Sheet Metal Worker's Instructor," Warn's; few copies, cheap, covers slightly soiled.—94, St. Augustine's Road, N.W.

Minerals, Fossils (Carboniferous, Lias), 12 specimens, 2s. 6d.; polished specimens, 6d. to 9d.—C. WARDINGLEY, Blackwood Crescent, Edinburgh.

Guide to Manufacture Tallow, Soaps, Washing Powders, Soda, Crystals, Liquor, etc., 2s.—30, Finlay Street, Sheffield.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

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Models, Scientific Apparatus, Tools, or Machinery taken in exchange for new goods or work done to order.—BUTLER BROS. 44, Elsden-road, Tottenham, London.

SELECTED BOOKS.

A Manual of the Mollusca. A Treatise on Recent and Fossil Shells. By Dr. S. P. Woodward, A.L.S. With Appendix by Ralph Tate, A.L.S., F.G.S. With numerous Plates and 300 Woodcuts. Fourth edition. London: Crosby Lockwood and Sons. Price 7s. 6d.

Elementary Microscopical Manipulation. By T. C. White. Illustrated. London: Roper and Crowley. Price 2s. 6d.

The Hessian Fly, Cecidomyia destructor, in Great Britain in 1887: being mainly Reports of British Observations, with Illustrations from Life, and some means of Prevention and Remedy. By Eleanor A. Ormerod. London: Simpkin and Marshall. Price 6d.

Precautions to be adopted in Introducing the Electric Light. With Notes on the Prevention of Fire Risks. By K. Hedges. London: E. and F. N. Spon. Price 3s. 6d.

A Manual of Dissections of the Human Body, for the Use of Students, and more Particularly for those Preparing for the High Examination in Anatomy. By the late R. E. Carrington, M.D., F.R.C.P. Second edition. Revised and Enlarged by W. Arbuthnot Lane, M.S., F.R.C.S. London: George Bell and Sons. Price 9s.

Natural History Object Lessons: A Manual for Teachers. By G. Ricks. London: Isbister and Co. Price 4s. 6d.

Electric Light Arithmetic. By R. E. Day, M.A., Evening Lecturer in Experimental Physics at King's College. London: Macmillan and Co. Price 2s.

Geometrical Drawing. For the Use of Candidates for Army Examinations, and as an Introduction to Mechanical Drawing. By W. N. Wilson, M.A., Assistant Master at Rugby School. London: Rivington and Co. Price 4s. 6d.

The Geological History of Plants. By Sir J. William Dawson, C.M.G., LL.D., F.R.S. With 80 Figures in Text. International Scientific Series. London: Kegan Paul, Trench and Co. Price 5s.

Tea Cultivation and Manufacture. By E. Money. Fourth edition. Whittingham. Price 10s. 6d.

NOTICES.

The Title Page and Index to Vol. I., *First Series*, now ready, price 6d.

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Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

BICENTENARY OF NEWTON'S PRINCIPIA.—In commemoration of the bicentenary of the publication of Newton's Principia, Dr. Glaisher delivered an interesting address last week at Cambridge. He pointed out that from the moment Newton considered the possibility of comparing terrestrial gravity with the force that held the moon in her orbit, he had formed the brilliant conception that attraction was an inherent property of every individual particle of matter. In this Newton never wavered, and between this very definite and accurate conception, and the vague notions about gravitation that were current in his day, there was an enormous difference. In 1685 there was his remarkable achievement of determining mathematically the attraction of a spherical mass, which had so important a bearing on the establishment of the theory of gravitation. The actual composition of the "Principia" was preceded by the attempt in 1666 to connect gravity with the moon's motion, and a correspondence with Hooke in 1679, when the elliptic orbit about the focus was demonstrated. In 1679 he was engaged upon other investigations, and laid aside the calculations he had then prepared. Five years later he was led to take up the subject again, but was then unable to find his previous calculations, and so was obliged to work them out again. With the exception of some minor propositions, the whole of the Principia was composed from very scanty materials in the short period of eighteen months—the result of a single continuous effort.

The great event that stands out conspicuously in this memorable time is the determination of the attraction of spheres, and this remarkable result was unexpected by Newton himself. The effect of this sudden transition from approximation to exactitude stimulated his mind to still greater efforts, and it was now in his power to apply mathematical analysis with absolute precision to the actual problems of astronomy. "Thus was it granted to one man to be the first to form a conception of the true principle that governed the universe, to give precise meaning to his brilliant conception, and by the aid of a mathematical weapon which he himself had forged to wrest from his great principle its varied and subtle consequences, and even in the most difficult problem of all, the motion of the moon, to outstrip the observations of his time."

MR. MATTHEW ARNOLD.—It is not for us to speak of the dead poet and critic, but at least we may pay our tribute to the man whose untiring efforts and acute thinking have done so much for the cause of primary and secondary education. His critical inquiries abroad, made in the capacity of Foreign Assistant Commissioner in 1859, and as a Special Commissioner in 1865, were fruitful seed in so fertile a mind, and the fruit they produced has led to a wide-spread demand for improvement in middle-class education—a demand which has silently and surely undermined the methods formerly in vogue, and broken down to some considerable extent the strange barriers of limitation which divided the "Philistines" from the "Barbarians" on the one hand, and the "Populace" on the other. For thirty-five years he was an Inspector of Elementary Schools, and he thus acquired a long and varied experience which was of great value, and his reports form a repository of wise suggestion whence may be drawn plans for steady progress in the near and remote future. At the same time the drudgery of such work must have been very irksome, although he performed it in a most exemplary manner, and it is to be

regretted that so large a portion of his valuable time should have been given to the mere examination of children in such elementary subjects as spelling and arithmetic, to say nothing of needlework!

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

The International Astrophotographic Congress presents an admirable example of general co-operation for a purely scientific object, an object that has the great merit of being commercially worthless, is without the remotest possibility of having any naval or military utility, and yet it has collected fifty-six eminent delegates representing France, England, Germany, America, Russia, Holland, Austria, Sweden, Denmark, Belgium, Italy, Spain, Portugal, Switzerland, Brazil, and the Argentine Republic.

France stands worthily at the head of the list, having initiated the movement, and having, so far, contributed the largest number of active workers. The work of the congress will be to produce a chart of the heavens with a degree of accuracy and detail which until lately has been unattainable, and which even now is only rendered practically possible by such international co-operation.

Photographs of every part of the heavens are to be taken from the most advantageous stations on the globe, with instruments that will be identical in all their essential parts, so that the different maps may be combined to form one harmonious picture of every celestial object down to stars of the 14th magnitude, *i.e.*, far beyond the reach of unaided human vision. The photographic plates will be in duplicate.

A second series of photographs, extending to stars of the 11th magnitude, will be taken with shorter exposure, concurrently with the first. All the photographic plates are to be prepared from the same formula, and the photographic telescope to be identical in all essential particulars with that used at the Paris Observatory by the brothers Henry, who have been the pioneers in the research. It is estimated that the total number of stars that will be shown in the plates reaching the 11th magnitude will be about three and a half millions, but the additional number that will appear between the 11th and 14th magnitudes is beyond the reach of safe estimation with our present knowledge of the subject. The mere counting of these will be an interesting work.

It is hoped that some years after the completion of this first great chart, another will be made under similar conditions. A comparison of these will help to solve the gigantic problem of the general movements of the stars which are inaccurately described as "fixed." We have the best of reasons for concluding that there exists nowhere in the universe such a thing as a fixed star, or any other fixed or motionless body. Gravitation is at work upon all, and therefore none can remain at rest.

If any one should ask the grovelling question of what is the use of knowing these things? I would tell him that man is superior to an ass, a pig, or an ape, because he has intellectual faculties, and moral sentiments that can contemplate and enjoy intellectual and sentimental objects, that he must either cultivate these specially human attributes, or revert more or less completely to the asinine, porcine, or simian type; that the pursuit of pure science has far more to do with truly human progress than the growth of wealth and luxury; that the increase of these without a corresponding development of pure intellect can only promote degrading, and ultimately destructive, sensuality.

The Society of Arts proceeds so steadily and quietly that only a few of us can estimate the magnitude of the work it has done and is doing. We rarely, for example, associate it with the progress of geology, but it is nevertheless a fact that this science, when a feeble infant, was adopted and cherished by the Society of Arts, which in 1802 publicly announced the following award:—"To any person who shall complete and publish an accurate mineralogical map of England and Wales on a scale not less than ten miles to an inch, containing an account of the situation of the different mines therein, and describing the kinds of minerals thence produced, the gold medal or fifty guineas."

It may be observed that the word geology does not appear here, the simple reason being that the babe thus taken under the Society's protection was not yet formally baptised. A near neighbour to the Society, William Smith, of Craven-street, Strand, and afterwards of Buckingham-street, was, however, working upon such a map as the Society demanded and finally produced it, receiving the Society's premium of fifty guineas in June, 1815. In the preface to volume 32 of the transactions of the Society is the following: "Under the class chemistry will be found an account of a most valuable mineralogical map of England and Wales, a labour of many years by Mr. William Smith, in which, he has, with infinite care and accuracy, pointed out the situation of the different strata of coal, lime, iron, stone, and other mineral products." Note the expression, "under the class *Chemistry*."

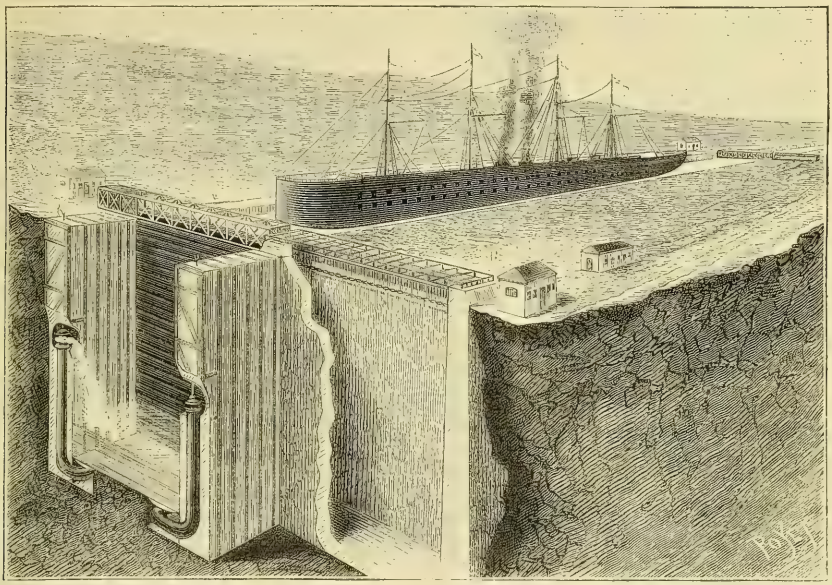
The map was on a scale of five inches to the mile, double that of the minimum required by the Society, and in fifteen coloured sheets. It was published by Carey in the same year as that in which the 50 guineas were given to its author.

Greenough's map of about fifteen years later was based on this, and the existing maps of the official Geological Survey are but further developments, with the Ordnance maps as a geographical basis.

This sound and thorough worker has been justly described as the father of English geology, and such a title is almost equivalent to that of the father of the science of geology as now understood. His predecessors were, for the most part, theoretical cosmogonists, "Vulcanists," "Neptunists," supporters or antagonists of Werner or Hutton, of de Luc or Woodward, etc.; combatants who attacked or defended the Noachian deluge, and all disputing on but a narrow basis of facts. Smith's work consisted in extensive observation and sound generalisation of the facts thus laboriously collected. As D'Aubuisson said, "What many celebrated mineralogists had only accomplished for a small part of Germany, in the course of half a century, had been effected by a single individual for the whole of England."

On page 235 of the current volume of this magazine is an account of some fossil tree-stumps found standing upright, or as described "*in situ*," with the usual inference that they must therefore have grown where thus found.

I have controverted this conclusion (see "Science in Short Chapters," page 88), not on any theoretical grounds, but as a simple matter of fact, which anybody may rectify by repeating my observations at the Aachensee in the Tyrol, and in the Norwegian fjords, where thousands of trees are annually swept down from the steep slopes on which they grow, with soil still adhering to their roots. This soil holds the floating trunks for a while in upright position, until sufficiently soaked to sink to the bottom of the lake or fjord, still with roots downwards, in which position they become either embedded in the deposit from the turbid inflowing waters of the head river, or if in the outer clear water of the lake or fjord, are in the course of centuries associated with other trees in sufficient quantity to become rotted down into coal-seam material.



THE PANAMA CANAL LOCKS.

ACCORDING to *La Nature*, the projected opening of the Panama Canal in 1890, depends on the adoption of a higher level in the Cordillera, and on the use of locks with a depth from 26 to 36 feet of water as proposed by M. Eiffel. These locks will be about 590 feet in length, and 58 feet in width.

For such pressures and for locks which have to be opened and shut frequently, the ordinary arrangement of lock gates in pairs is not suited. Hence M. Eiffel, with the concurrence of M. Bunau-Varilla, proposed a single lock gate to run on rollers as used by M. Kimpple since 1874 for the docks at Greenock and elsewhere. Instead, therefore, of the lock being closed by a pair of gates opening and turning upon hinges like ordinary gates, the canal will be closed by a single sliding gate which moves vertically to the line of the canal.

This gate is a rectangular structure of iron forming a large hollow caisson moved by means of rollers running on a tramway laid on a bridge placed above the gate when the lock is closed. When it is to be opened the gate is run into a side chamber made for its reception in the bank of the canal, as shown in the accompanying illustration, and the bridge is then swung round on a pivot so as to leave the canal passage clear. The lock gate is formed of numerous water-tight compartments, independent of each other, and it is possible to introduce into them at pleasure either water to equalise the pressure, or compressed air to allow of the compartments being examined and repaired.

As the gate has a slight lateral movement, it cannot remain jammed against its supports, an accident which frequently occurs in similar systems, and even in gates made in pairs. Further, as the sliding-gate is buoyant, it does not weigh heavily upon its bearings and impose any severe strain upon them. A very little power is sufficient to open and close the lock quickly. In the opinion of competent engineers, this system is considered the best for locks having a great fall of water. The gates are, of course, only moved when the level of the water is the same on each side. Provision must, therefore, be made for passing from one side to the other, the enormous quantity of 1,400,000 c. ft. of water in fifteen minutes at the utmost, and this without undermining the lock sills, and without producing such a movement in the water as would drive vessels against the banks and cause them to come in collision. To this end M. Eiffel causes the water to flow in through a series of vertical pipes on each side of the lock, instead of escaping laterally through a few large openings.

We are indebted to our contemporary, *La Nature*, for the illustration we give, and for the information upon which our description is based.

FORAMINIFERA.—I.

BEFORE the days of defined scientific, and especially microscopical research, there had been a general tendency, though lessening from past to more recent times, to suppose that any study which regarded natural things of small size, or those that would not give up their secrets of origin and habits to a casual observer, must in some degree be associated with the idea of low aim in intellectual work. Doubtless had Marcus Aurelius lived at the present day the following would not have appeared. The imperial philosopher says:—"Some people are little enough to be attracted by things in a state of bare existence or vegetation, as with stones, wood, figs, grapes, olives, and such like. Others, who are somewhat more reasonable in their fancy, must have life to charm them; and these it may be are in love with their flocks and herds. A third sort, better furnished than the former, admire nothing beneath a rational soul." It is, however, clear to all who inquire into these things that, just as it would be irrational to call the work of a watchmaker inferior to that of a man who worked only upon cathedral clocks, so also would it be to suppose any inferiority in the study of the minute or the apparently simple forms of creation, when compared with those of more specialised characters.

Looking into Nature's ways of working, we can never fail to notice evidences on all sides of the infinite resources which have been drawn upon to furnish and endow each form of animal life with perfect ability and material for its existence. To no other group of animal life does this apply with more force than to those creatures called Foraminifera. They give us an instance of a simple form of life, as far as our optical appliances are able to inform us, constructing in very many instances a shell of wonderful complexity and of excessively fine textural structure. As members of the class Rhizopoda, they are related to the Amœba of our ponds, which, however, have no shell substance investing the body, though the allied forms *Arcella* and *Difflugia* have a partial encasement of a horny substance and of cemented sandy and other materials respectively. Animals of this class have in common means of locomotion and of prehension combined, afforded by the filaments or extensions of the body substance (protoplasm), which they send forth at will, if such a primitive jelly-like creature can be said to possess one. The Amœba sends out these processes finger-like, Difflugia and others in more slender form, while the body substance of the Foraminifera is exuded from the shell as a mass of filaments, ramifying, and at points coalescent, perhaps surrounding some minute organism. These two groups of the amœbiform animals (*lobosa*), and the foraminiferal (*reticularia*), together with the *Actinophrys* of fresh water, and the marine forms, the *Polycistins* (radiolaria), constitute the class of Rhizopods or root-footed creatures.

The minute shells of Foraminifera are familiar to all who have possessed a microscope, but they may have only been known as "pretty objects," perhaps arranged in some conventional design, which before now has taken the form of a street lamp. So much has yet to be learned concerning the method of growth, the habitat, and variation during the successive periods of the earth's history, of each of these interesting forms, that any patient research will be amply repaid by the accession of new facts which are sure to be made to the information already gathered on this subject.

The classification of this group has of necessity to be based on the form and structure of the shell, and though this at first may seem very artificial, yet on consideration it will be seen to involve a good natural idea of the animal itself, as far as regards structure, inasmuch as the shell is generally so well permeated by and moulded upon it, that a very intimate relation exists between the two.

A classification based on the arrangement of the chambers was attempted by d'Orbigny in 1826, and augmented by him in 1852. He formed for the Foraminifera seven orders, which were as follows:—The first order of the Monostegian Foraminifera comprised those in which the shell consisted only of a single chamber, as in *Lagena* (fig. 11). The second, or Cyclostegian order, was that in which the shell is formed by a cyclical or concentric series of chambers, resulting in a disk-shaped form, as in *Orbitolites*. In the third group of Stichostegian shells we find those forms which consist of chambers joined end-wise in a straight or curved line, as in *Nodosaria* (fig. 12), *Frondicularia*, and *Dentalina* (fig 13). The Helicostegian forms in the fourth order were those in which the chambers are in a single series and coiled to form a spiral shell, as in *Cristellaria* (fig. 14), and *Globigerina* (fig. 16). The fifth order of Entomostegian shells were characterised by a double series of chambers coiled spirally, as in *Bulimina* and *Uvigerina* (fig. 15). In the sixth order of Enallostegian shells we have the chambers arranged alternately in two or three rows, but not spirally, as in *Textularia* (fig. 10). The seventh, and last, order of the Agathistegian Foraminifera comprised those whose chambers, each formed around a central axis, encompass half the shell, as in *Miliolina* (fig. 5).

This arrangement is now found to be of little utility, on account of the graduation from one form into another, which prevents the formation of distinct groups if only the arrangement of the chambers be regarded, without taking into consideration other points, such as the structure of the septa and chamber walls; and also on account of some forms possessing two, or even three, modes of growth at different stages of their existence. The later methods of classification include the minute structure of the shell, which is often of as much importance as external form.

The shells of the Foraminifera are grouped mainly in two divisions, the first of which is the Porcellaneous type, characterised by a calcareous shell of a smooth texture, sometimes chalky white, and not perforated on the surface by numerable holes, as in the next group. The great division of the Hyalina, or the glassy type of shell structure, is recognised by the shell substance being thickly perforated with numberless minute pores, or tubules, through which the sarcode of the animal, when alive, oozes. Intermediate in position to these groups there is another, comprising the Arenaceous types, or those which form their tests or investments of sand-grains, comminuted shells, sponge spicules, or even the shells of their own kindred compactly cemented, often appearing rough on the outside, but which in many are glazed internally.

A general idea of the shell structure of the two groups will be obtained from the drawings of median sections taken through specimens of *Peneroplis* (fig. 1), and *Marginulina* (fig. 2), of the Porcellanea and Hyalina respectively. The method of preparing these sections will be described in the latter portion of this paper. In

the first section of *Peneroplis arietinus*, Batsch (fig. 1), in which at first the chambers grow on a spiral plan, ultimately extending in a rectilineal manner, the stolon passages by which the sarcode, or body substance, in each chamber is connected, may be distinctly traced perforating the septum or floor of the latter, passing through that of the first or oldest septum, and through each in succession to the one last formed, which emits the pseudopodia. It is also to be remarked that however high the magnification used in examining a section, no perforation of the outer wall of the shell can be seen in this type, as in those of the other division, it appearing as a homogenous translucent substance throughout; hence the name Imperforata applied to these forms. In the second section (fig. 2) of *Marginulina Wetherellii* the figure of which shows only a portion of the outer wall of the shell, we observe countless striations across the shell-layer; these are the tubules, through which the sarcode filaments pass to the outside. The tubules in this specimen are about $\frac{1}{10000}$ of an inch in diameter. It

FIG. 1.—*Peneroplis arietinus*. Batsch. Median section, showing stolon passages. × 30.

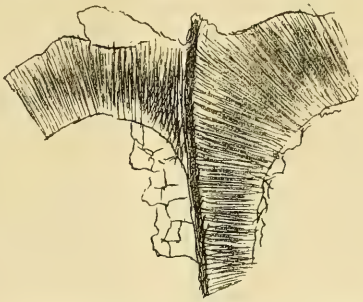


FIG. 2.—*Marginulina Wetherellii*. Jones. Small portion of tubulated wall. × 180.

FIG. 3.—*Biloculina ringens*. Lam. Sp. × 30.

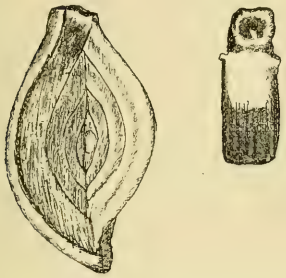


FIG. 4.—*Spiroloculina limbata*. d'Orb. × 30.

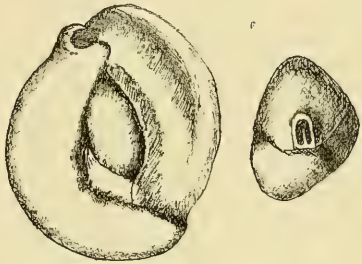


FIG. 5.—*Miliolina seminulum*. Linné Sp. × 30.

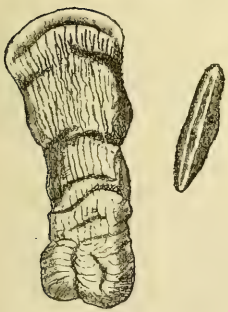


FIG. 6. — *Vertebralina striata*. d'Orb. × 30.

FIG. 7.—*Cornuspira involvens*. Reuss. × 40.

FIG. 8.—*Peneroplis pertusus*. Forsk. × 30.

is most probable that when the tubuli are so excessively fine, the protoplasm is exuded in a gelatinous mass around the exterior of the shell, and may from that break up into filaments.

Having referred to some of the fundamental details of the order, we now proceed to notice briefly examples from some genera the most noteworthy, or whose shells predominate in accumulations formed by them.

The first genus which we have selected is Biloculina, where the contour of only two of the chambers appears at the surface. The shells of the Milioline Foraminifera consist of more or less hemispherical chambers wrapped round an imaginary axis, and divided from each other by a constriction only, at each end of their length. They also have a shelly projection, termed the tongue or valve, within the aperture, joined to the inner side. *Biloculina ringens*, Lam. sp. (fig. 3), is a form to be found in recent shore gatherings from our own coasts, and which has been obtained elsewhere from the depth of 3,000 fathoms. It also occurs fossil in the crag beds of Suffolk, and in the Eocenes of the Paris Basin. The next example, *Spiroloculina limbata*, d'Orb. (fig. 4), taken from a specimen found near Alexandria at 30 fathoms, occurs frequently at slight depths in the Mediterranean and elsewhere. The shells of this genus consist of Milioline chambers coiled in a plane, so that the full number of chambers is apparent on both the upper and lower faces. The form selected from the genus Miliolina is *M. seminulum*, Linné sp. (fig. 5), a very variable shell, and one of the most abundant in the tide pools of our coast. The illustration gives the extreme discoid or broad form; gradations may be noticed in this type passing from the broad shell into the narrow *M. oblonga*, of Montagu. *M. seminulum* has also been found in many fossil deposits of Pliocene and Eocene ages. In the next genus taken, Vertebralina, the first formed chambers take the arrangement of a Milioline form, but subsequently in the last two or three chambers the latter are joined end-wise in a single series. The aperture is a narrow slit traversing the width of the latest-formed chamber. The example taken is *V. striata*, d'Orb. (fig. 6), a shell found in warm latitudes, distinguished by the beautiful longitudinal striations commonly seen on its surface. It is essentially a shallow-water form, and has been found in British waters. The characters of Cornuspira are a cylindrical shell wound spirally on a plane not chambered and possessing a single aperture. The genus Ophthalmidium forms a link between this genus and the Miliolines, in that it possesses a shell like that of Cornuspira, but with partial septa at intervals. In *C. involvens*, Reuss (fig. 7), which is more frequent in moderately shallow than in deep water, we have a form which is slightly concave on both surfaces, and with the successive whorls impressed upon the preceding ones. In Peneroplis, the disposition of the chambers is at first spiral, which afterwards may be continued in a straight line. A common example is *P. pertusus*, Forsk. (fig. 8), abundant in the Mediterranean and elsewhere, in which the flat spiral form rapidly widens out, so that the latest portion can curve over to join the early spiral portion. The pseudopodia are protruded from a series of apertures perforating the septal wall of the last chamber.

(*To be continued.*)

SCIENCE IN RUSSIA.—The Russian Government has established a zoological station in the Bay of Villafranca.

THE CLOUDINESS OF THE SKY AND THE PRODUCTS OF THE LAND.

Ciel et Terre gives an abstract of an interesting communication on this important subject lately made by M. Renan to the Meteorological Society of France. The cloudiness of the sky, unfortunately too much ignored in many observatories, is an extremely important factor in the growth of crops. Everyone knows that for some forty years severe maladies have attacked plants, especially the potato and the vine.

These diseases have for their primary cause the abuse of cultivation, the excess of production, but like all infectious and epidemic maladies, they are propagated by organic germs which have existed at all times, but which have been developed in an extraordinary manner under the influence of certain atmospheric excesses.

Attempts have been made to find the cause of the mischief in the extreme and the mean temperatures, but no satisfactory conclusion has been reached. Thus the seasons 1838 to 1845 have been very bad; their mean temperature 10·2° C., as registered at the Observatory of Paris, being 0·5° below the normal mean, which is very striking for a series of eight consecutive years. But it would not be difficult to find other series of years as bad, for instance the eight years 1809-1816, which, notwithstanding the intervention of an uncommonly hot year (1811), shows a mean of only 10·3°. The year 1811, moreover, though meteorologically splendid, was like 1846 a year of great dearth.

The cause of agricultural disasters must not be sought for in the temperatures, but in the cloudiness of the sky.

In the eight years 1809-1816 this nebulosity was 65 (if 100 be taken to represent a sky entirely overcast), whilst the cloudiness of the year 1816 reached the exceptional figure of 71.

In 1838 to 1845 the mean nebulosity was 70; but the most remarkable feature of this term is the cloudiness of July.

The mean cloudiness of this month is well known. According to the observations of 120 years it is 52; in the 39 years from 1846 to 1884 it is also 52. At the Park St. Maur, near Paris, where M. Renan has his observatory, it is 51 for the 14 years 1873-1876. But the mean cloudiness of the six July's 1840-1845 was 72·5°, which is the ordinary figure for January.

Here, we cannot doubt, is the true cause of parasitic diseases due to the exceptional lack of sunshine during the principal summer month in these unhappy years.

THE BAKU NAPHTHA SPRINGS.—Although within the last two years intelligence has frequently reached Europe of extraordinary outbursts of mineral oil on the Apsheron peninsula, near Baku, nothing has yet equalled the astonishing outbreak which the Northern Telegraph Agency telegraphed some time ago. Their telegram was to the effect that near the petroleum works of a certain M. Arafeloff a fountain of oil was throwing out over 2,400 tons daily, that this had been continuing without intermission for four weeks, and that more than the half of this enormous output was going to waste. It is to this loss of the oil that attention is now being directed. Not only at Arafeloff's fountain, but at almost every large fountain in the Balakan-Sabuntchin district the waste of this most valuable product has been enormous. Millions of poods of oil have been lost owing to the inefficient way in which it is reservoired and stored. It is now understood that the Government will take immediate steps to prevent this ruinous waste and to compel the owners of oilsprings to adopt more scientific methods of boring, collecting, and storing.—*Times*.

General Notes.

Red Snow.—The curious phenomenon was observed the other day in the Gail Valley, Tyrol. It appeared the size of the hand on the white surface of the snow, and when left to melt on a piece of paper there remained a brick-coloured sediment.

American System of Water-purification. — This system, proposed by Dr. A. R. Leeds, consists of three processes—artificial aeration under pressure, precipitation by alum, and lastly, mechanical filtration under pressure.

A curious Drug.—Attention has lately been called to an acid extracted from *Gymnema sylvestris*, a climbing plant from India. This acid deprives the tongue for the time being of the power of distinguishing sweet from bitter substances. It does not interfere with the taste of saline substances.

The Use of Cotton Oil as an Adulterant. — The French papers seem at present much exercised concerning the use of cotton-seed oil in the sophistication of olive-oil. They pronounce the former oil a decided poison. We must confess that we know no facts on which this charge can be based.

Two Forms of Deafness.—According to Dr. Boucheron (*Comptes Rendus*), certain deaf persons do not hear the fundamental sounds—those produced in the larynx—but perceive the harmonic sounds produced in the pharynx, the mouth, or the nose. Dr. Boucheron shows that there are also inverse effects where only the harmonic sounds are heard.

Heating of Railway Carriages by Gas.—Experiments have been in progress of heating railway carriages by gas. The method adopted is the invention of Mr. Foulis, Gas Engineer to the Corporation of Glasgow. The feature of the invention is the placing of a small boiler above the lamp, which is fixed in the usual way in the roof of the compartment. The water in this boiler is made to circulate by means of an arrangement of valves through pipes, placed under the seats. The experiments have been carried out in carriages belonging to the Glasgow and South-Western Railway.

Mirage.— On April 4th, for an hour or two, the coast of East Lothian and east as far as St. Abb's Head was seen as clearly from the High Common, Arbroath, as if it were not ten miles distant. It was chiefly covered with snow, while between the hills, there being no snow, the surface was dark. So vivid was the mirage that woods or even buildings could be seen with the naked eye, while the general view extended for miles inland.

To Break Cast-Iron.—According to the *Iron and Steel Trades Journal*, a method of breaking large pieces of cast-iron is to drill a hole in the part to be broken, say one inch in diameter and of proper depth, a steel plug is then fitted fairly tight to the hole, and then one half or two-thirds of the hole are filled with water. If the plug be inserted and driven down hard with a heavy hammer, the desired result will be obtained.

Preservation of Individuality in Schools.—Mr. D. S. Marvin, in the *Popular Science Monthly*, points out the necessity of giving free play to individuality of tastes, faculties, and character. Nothing can be more fatal to eminence than the notion of "Standards." From the same reason military men are, of all others, the least qualified to act as inspectors of schools, heads of colleges, etc., since their entire training leads them to arrest every manifestation of originality in persons placed under their orders.

What is Orosnes?—*Orosnes*, the root of *Stachys affinis*, much in use in Japan as an article of diet, is coming into use in France and Belgium. The esculent portion consists of small root-stems, of about the thickness of a finger. The flavour is said to be not strongly marked, but agreeable, recalling at once the artichoke, the potato, and salsify. The plant is very hardy, flourishes in poor soils, and bears the severest weather. The crop is fit to gather in November.—*Bulletin Agric. du Midi.*

Monument to Pierre Belon.—A statue to this eminent naturalist has just been erected at Mans, more than three centuries after his death. Belon was born at Souletière, a hamlet in the parish of Oisé, in Maine, about 1518. He studied medicine, travelled much in Germany, Bohemia, Greece, Egypt, Palestine, and Asia Minor. Besides an account of his travels he published works on birds and fishes, and was engaged on a work on agriculture, when he was assassinated in 1564 in the Bois de Boulogne.

Seeming Death and Premature Burial. — The *Journal des Savants*, in discussing the signs of death, mentions three cases of resuscitation after apparent death. In one of these the body, a General killed, as it was thought, in the retreat from Moscow, had been already buried, but was dug up with the object of removing it to France, and was found to give signs of life. In 1826 a young priest returned to life at the moment when the Bishop of the Diocese was chanting the *De profundis* over his supposed remains.

Penalties for Adulteration in France.—A butter merchant of Lisieux lately convicted of having sold as "pure Normandy" butter, mixtures containing from 25 to 40 per cent. of margarine, was sentenced to three months' imprisonment, a penalty of 3,000 francs and full costs; 20,000 lbs. of the mixture were confiscated. It was further ordered that the sentence should be published in 20 specified papers, and posted on the doors of the town halls, and in the market places of three towns on three consecutive market-days.—*Analyst.*

A Shower of Mud.—The *Courier de l'Europe* records a shower of blackish mud which fell at Naples, on March 17th. Professor Palmieri shows that the phenomena is very simple in its origin. Violent winds in Africa raise up columns of dust and sand, which are swept over the south of Europe. It readily happens that rain, falling through these clouds is rendered turbid. If the dust is black there is a shower of mud. But if it is red, ferruginous matter the rain is red, and we have the still more alarming phenomenon of a "shower of blood."

Bacteria in Ice.—According to Prudden (*Revue Scien-*

tifique and *Naturforscher*) prolonged freezing decidedly reduces the number of bacteria in water. Before freezing a sample of water contained (per cubic centimeter ?) 6,300 individuals of *Bacillus prodigiosus*. After four days' freezing the number was only 2,970; after 37 days 22, and after 51 days none. Bacteria can resist a long continuous cold much better than rapid changes from low to high temperatures and inversely. The bacillus of typhus fever has an exceptional power of resisting cold.

Heating Effect of Electric Currents.—A contemporary says: "M. Cailletet, a French electrician, has conducted a series of experiments which show that the heating effect of an electric current, as shown in a piece of platinum wire, is proportionately diminished as the pressure of the air around such wire is increased. The converse has long been established. M. Cailletet has shown that a current which would fuse a wire under ordinary pressure will scarcely raise it to redness when the pressure is sufficiently great. This shows how essential free convection and radiation are to the incandescence of the filaments of glow lamps."

The Outline of Continents.—Mr. A. Agassiz, in his work on American "Thalassography," contends that the real outline of the continents is the "hundred fathom line," which often, though not always, corresponds to the present coast line. Beyond this line the descent to the depths of the ocean is very steep. The space between the coast-line and the margin of the hundred-fathom line, is spoken of as the continental shelf. It is covered with the *débris* brought down by the rivers from the land. Professor Agassiz seeks to prove that the great continental areas and the great ocean basins must always have maintained their present relative positions.

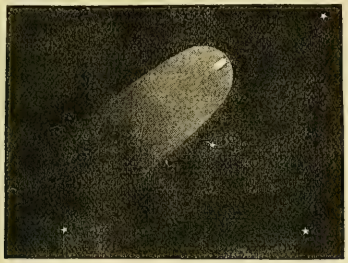
Preserving the Natural Colour of Flowers.—The *Phar. Jour.* draws attention to R. Hegler's method of preserving the natural colour of flowers, which consists in dusting salicylic acid on the plants as they lie in the press, and removing it again with a brush when the flowers are dry. Red colours in particular are well preserved by this agent. Another method of applying the same preservative is to use a solution of one part of salicylic acid in fourteen of alcohol by means of blotting-paper or cotton-wool soaked in it, and placed above and below the flowers. Powdered boracic acid yields nearly as good results. Dr. Schönland (*Gardener's Chron.*) recommends as an improvement in the method of using salicylic acid for preserving the colours, that in the case of delicate flowers they might be placed loosely between sheets of vegetable parchment before immersion in the liquid, so as to preserve their natural form.

Forestry and Locusts in Cyprus.—From the recently issued report of Her Majesty's Acting High Commissioner at Cyprus for 1886-7 we regret to notice that tree planting has not been carried out to the extent that is desirable from want of funds. About 3,000 trees have been planted round Nicosia during the year, and about 2,600 given away to villagers who are glad to get them. One hundred and sixty eucalyptus have been given to the Commissioner of Nicosia to plant round the Mudirate at Morphon. Up to the date of the report they were doing well, but as no funds were available for protecting them against the straying village animals the Forestry Inspector is afraid they may be eaten off. The *Quillaria saponaria*, sandal, sweet chestnut, and cork oak, mentioned in the report of 1884-5 as having been planted, have all failed, mainly from the excessive heat. Though there is a marked diminution in the illegal cutting of trees still the Inspector complains seriously of the damage done by goats to the young trees. Little progress in forestry will be made in Cyprus until young plantations are effectually fenced against the inroads of the goats. The results of the Locust Campaign of 1886-7 are reported as on the whole satisfactory. The Government Engineer states that during the past four years little or no damage has been done by the common locust. The results would have been much more favourable if the people generally took more interest in locust destruction and worked earnestly for their extermination.

The Past Winter in North Italy.—Dr. G. Hellmann, the well-known meteorologist of Berlin, has published some data respecting the climatic conditions of Upper Italy during the past winter which possess general interest. Within recent years the winter has only once been so severe in Italy as that from which we are just emerging—namely, in December, 1879, and January, 1880. The Riviera then suffered even more than this winter, while for Upper Italy the conditions were about the same. According to Dr. Hellmann, the thermometer fell in Genoa and Porto Maurizio (12½ miles east of San Remo) ten times below freezing point from the end of December, 1887, to the beginning of February, 1888, and twice as many ground frosts and hoar frosts were observed. The lowest air temperatures in the Riviera were, according to the situation of the place of observation, between —3 deg. and —6 deg. C. (26 deg. and 21 deg. Fahr.). About 25 miles north of Genoa, in the longitudinal axis of the Po valley, on the contrary, the thermometer fell repeatedly to —15 deg. C. (5 deg. Fahr.) and even —17 deg. C. (1·4 deg. Fahr.). From December 26 to January 23, consequently for nearly thirty days, the temperature remained at Alessandria uninterruptedly below zero. During the period between December 21 to January 31, the following *minima* of temperature were registered:—Alessandria, —15·6 deg. C. (about 4 deg. Fahr.); Pavia, —12·7 deg. C. (8 deg. Fahr.); Piacenza, —17 deg. C. (1·4 deg. Fahr.); Cremona, —13·5 deg. C. (7·5 deg. Fahr.); Mantua, —11·8 deg. C. (11 deg. Fahr.); Ferrara, —13·6 deg. C. (7·5 deg. Fahr.); Rovigo, —15 deg. C. (5 deg. Fahr.); Milan, —8 deg. C. (17·6 deg. Fahr.); Padua, —8·9 deg. C. (15 deg. Fahr.); Turin, —10 deg. C. (14 deg. Fahr.); Venice, —6·2 deg. C. (20·5 deg. Fahr.); Parma, —13·7 deg. C. (7·5 deg. Fahr.); Ravenna, —12·6 deg. C. (8 deg. Fahr.). "From January 1 to 10, 1888," says Dr. Hellmann, "the temperature on the plateau of Cuneo was only about 8 deg. C. (about 15 deg. Fahr.) higher than in the valley of the Tanaro, near Alessandria, which lies 1,476 ft. lower, and the well-watered lowland bay of which, as well as the Po valley near Piacenza, may be called the Italian Siberia." It may be finally remarked that, according to the data furnished by Dr. Hellmann, during the period above mentioned, the following lowest temperatures were registered in various parts of Italy:—Florence, —6·5 deg. C. (about 20 deg. Fahr.); Rome, —3·4 deg. C. (25 deg. Fahr.); Naples, —1·7 deg. C. (29 deg. Fahr.); Cozenza, —3·8 deg. C. (24 deg. Fahr.); Palermo, —0·2 deg. C. (31 deg. Fahr.).

THE COMET (1888a).

ON the 19th of February, Mr. Sawerthal, of the Royal Observatory of the Cape of Good Hope, whilst returning from the Photographic Observatory noticed an object in the sky which looked very much like a comet, and his suspicion was converted into certainty when he came to examine it with a telescope. From calculations made by Mr. Finlay, it appears that the comet was nearest the sun on the 19th of March, its distance from him



being then about sixty-five millions of miles. Since its discovery the comet has been travelling in a north-easterly direction, and has lately been seen in the early morning in England; it is, however, only just visible to the naked eye, and is diminishing in brightness. Our illustration, borrowed from the *Scientific American*, is from a sketch made by Mr. W. R. Brookes, of the Red House Observatory, Phelps, N. Y., on March 25th. The nucleus was considerably elongated, and the tail was short and broad.

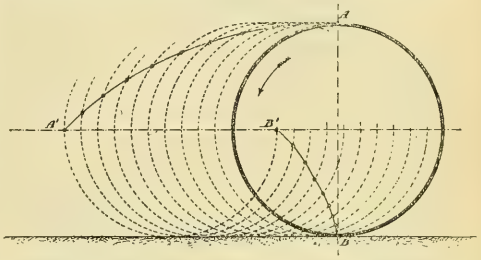
THE EFFECT OF GAS UPON PAPER.

HERR J. WIESNER has sent to *Dingler's Journal* a further communication upon the discoloration of papers by light. He has already shown that papers containing woody fibre rapidly become yellow under the influence of light, owing to oxidation chiefly induced by the more refrangible rays, and that wood pulp papers would naturally be specially liable to discolouration. Gas is less active than electric light in this respect, owing to the comparative absence of actinic rays from the former. It has lately been declared that gas acts prejudically upon paper in other ways, and is therefore unsuitable for lighting libraries; and Herr Wiesner has instituted careful experiments with a view to test the truth of these assertions. He had before demonstrated that a wood paper after four months' exposure at a distance of 0·75 meter from an eight-candle-power gas flame, was not discoloured more than by two hours' exposure to direct sunlight. He, therefore, now exposed wood paper to such other conditions as might be found in badly ventilated rooms lighted by gas. After an exposure of 5,400 hours, during which the temperature was not allowed to rise beyond 21° C. (70° Fahr.), it was found that the gases composing ordinary coal gas, whether in their usual state or mixed with a fair proportion of oxygen, were incapable of acting upon the paper. Strips of paper were next placed in a dark-room, and in a shaded position in a chamber, so badly ventilated that the illuminating power of the flame was distinctly diminished; other pieces being at the same time placed in a current of air in glass tubes exposed to the light of the flame. After about twenty weeks, the exposed papers, in common with all the other contents of the chamber, were covered with an equal depth of a light brown sooty deposit, while those in the glass tubes were unaltered. The woody paper alone had the faintest yellow colouration, due to the action of the light. The products of combustion of coal gas do not, therefore, discolour or affect paper in any appreciable degree; and thus it follows that gas may be freely used in libraries that are properly warmed and ventilated.

A WHEEL PUZZLE.

SOME of our readers are doubtless aware that when a wheel is travelling, the top of the wheel moves more quickly than the bottom. It is an old problem, but as we have recently heard it much discussed, we think a few words of explanation may be welcome. To those who have not already tried it, we recommend it as an amusing exercise in geometry.

If a wheel rotates on a fixed axis, all parts of its circumference move at the same rate, but when the wheel is also travelling in a horizontal direction, as in the case of a carriage wheel, we have to consider not only the



movement of the wheel about its axis, but the effect of the horizontal movement also.

Let the circular thick line in the diagram represent the wheel, and suppose that it is turning and travelling in the direction indicated by the arrow. When the wheel has made one-fourth of a revolution, the point A at the top of the wheel will have reached A′, and the point B at the bottom of the wheel will have reached B′. Therefore, during the same length of time, the point A′ on the top of the wheel must have travelled a longer distance than the point B on the bottom.

The reason of this is that the horizontal motion increases the distance A has to travel, while at the same time it decreases the distance B has to travel. It is, in fact, evident that were it not for this the wheel would remain in the same place, and would not get over the ground at all.

We may add that if a photograph of a moving carriage wheel be examined, it will be seen that the upper spokes are more blurred than the lower ones, and this is simply due to the greater speed with which the upper part of the wheel travels.

PUBLIC LECTURES ON HYPNOTISM.—According to the *Medical Press* a committee appointed by the Academy of Medicine in Belgium, to investigate and report on the effects of public exhibitions of hypnotism, reports that they are hurtful, physically and morally, and recommends their prohibition.

THE HYPOTHESIS OF ADHEMAR.

M. D'ABBADIE (*Ciel et Terre*) gives a summary of the views of Adhémar, which, he says, are at least worthy of a scientific refutation, but have never received it. This theory is based on a supposed periodical displacement of the earth's centre of gravity from the northern to the southern hemisphere every 10,000 years, followed by the transfer of the bulk of the water. Thus land would alternately predominate in the northern hemisphere, as we find it at present, and in the southern. Adhémar maintains that our hemisphere was gradually becoming warmer and warmer until the middle of the thirteenth century. Since that time our climate has been deteriorating, and in 10,000 years, dating from A.D. 1250, the southern hemisphere will have reached a maximum of warmth, and the northern its maximum of cold, forming a new glacial epoch. The displacement of the centre of gravity he assumes to be effected by means of the alternate accumulation of an "ice-cap" at either pole, whilst it is melting away at the opposite. He believes this cap to rest, not upon circumpolar land, but upon the sea-bottom, and to attain a height, not of twelve or twenty-four miles, as Dr. Croll surmises may possibly be now the case at the South Pole, but of sixty miles. Each hemisphere, according to Adhémar, is in turn colder and hotter. On the warm hemisphere, where the ice-cap is decreasing, the sea retires, and it gains ground on the colder hemisphere, where ice is accumulating. In a period of 10,000 years the conditions are reversed, this reversal being attended, not incidentally, but of necessity, by a universal deluge The last great catastrophe of this kind was the Noachian flood, when, according to Adhémar, the great ice-cap then existing on the North Pole collapsed, and the preponderating amount of water which had been collected in the northern hemisphere rushed across the globe to its present position in the south. On this hypothesis it seems to us that the southern ice-cap must continue to increase for about another eight hundred years from the present date—so as to make 5,000 years from the era of the Noachian deluge—whilst the southern hemisphere becomes still colder, and the sea gains ground upon the land.

It will not escape our readers that the figures which we have quoted from M. d'Abbadie lead to a different conclusion. He holds that the maximum of heat for the northern hemisphere and that of cold for the southern hemisphere are already past, whilst if they are to fall after the lapse of 5,000 years from Noah's flood, we must expect them about A.D. 2652. M. d'Abbadie thinks that the southern hemisphere has grown warmer since the voyages of Cook in the last century. Not long ago we saw it remarked that the climate of South America must be growing colder, since in the La Plata country houses were formerly built without any arrangement for artificial warmth, whilst now stoves and hearths are becoming common.

Returning to our summary of the views of Adhémar, we find that at the expiration of a certain time, whether it be A.D. 1250 or 2652, the southern ice-cap begins to decrease and its northern antagonist to preponderate. The maximum amount of water recedes from the southern hemisphere, and encroaches upon the land in the north. Finally, when 10,000 years from the time of Noah have expired, and when the winter of the southern hemisphere approaches perihelion, "the ice grows soft and rotten from the accumulated heat, and the sea begins to eat into the base of the cap, which is so undermined as to be left standing upon a kind of gigantic pedestal. This disintegrating process goes on until the fatal moment at length arrives, when the whole mass tumbles down into the sea in huge fragments, which become floating icebergs. The attraction of the opposite ice-cap, which has by this time nearly reached its maximum thickness, becomes now predominant. The earth's centre of gravity suddenly crosses the plane of the equator, dragging the ocean with it, and carrying death and destruction to everything on the surface of the globe."

We need scarcely say that this theory does not harmonise well with established facts in climatology, geology, and animal geography. It is now found that the average temperature of the southern hemisphere is not, on the whole, lower, but slightly higher than that of the northern. As far as we can judge, the polar ice-caps rest not upon the bottom of the sea, but upon land, so that a rise of temperature, though it might gradually melt the ice, could not bring about that sudden catastrophe which the theory demands. If the caps did rest upon the sea-bottom, their bases would be about the last parts to be eaten into, since in all parts of the globe alike the depths of the ocean have a very low temperature, little above freezing-point.

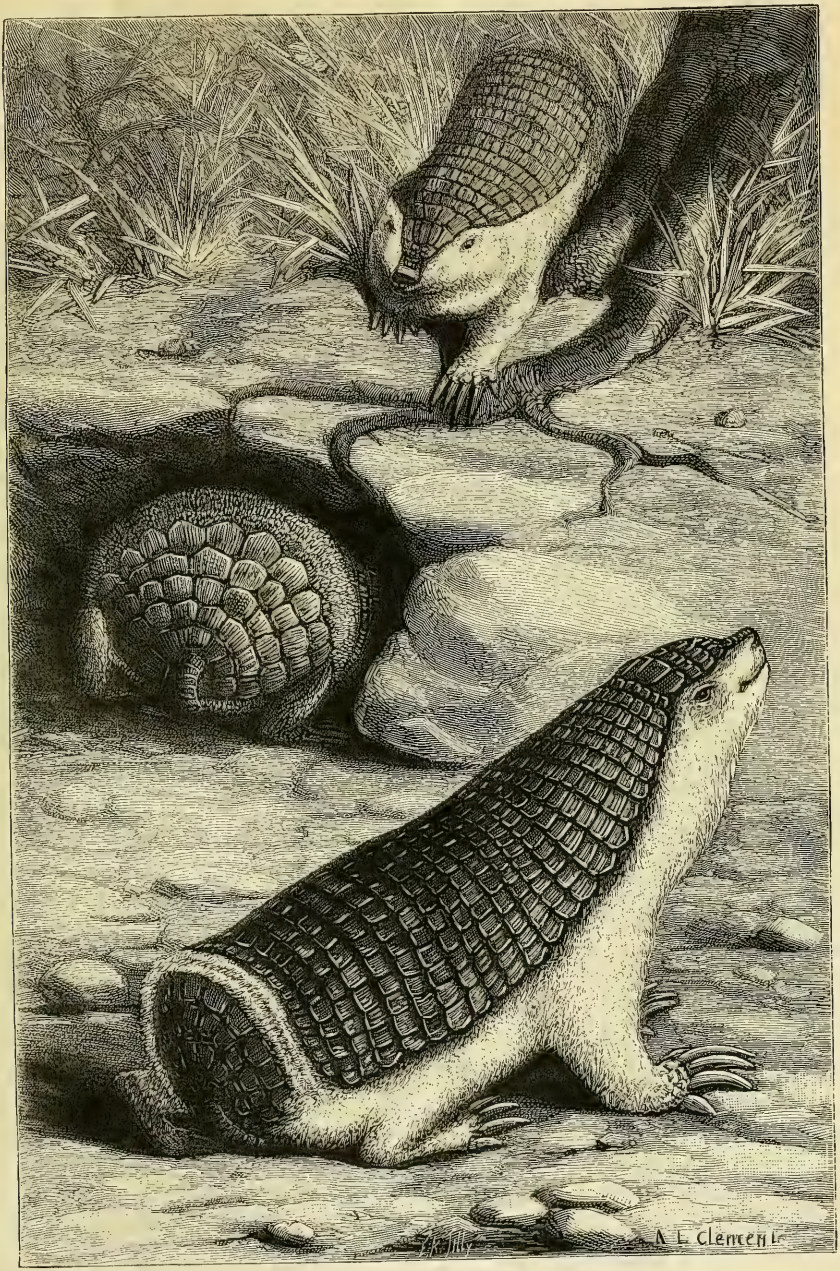
There are certainly places where the sea encroaches upon the land, and others where the land gains upon the sea. But such places often lie side by side, and are not distributed by hemispheres. It seems probable that Australia at one time extended eastwards as far as the "barrier reef." But South America—at least, on the western side—is rising out of the sea. The land along some parts of the Baltic is sinking, and in others being upraised.

We have proof, almost, if not quite absolute, that certain parts of the earth have not been submerged for a length of time, even greater than this theory would imply. The so-called "diluvial deposits" do not cover any of the higher parts of the mountains, say, above 1,000 feet. The ancient Egyptians and the black races of Africa have no traditions of such a deluge as is here intimated.

The distribution of animal life appears intelligible only on the supposition that on the land it has gradually spread from the North Pole, whilst in the ocean it has extended in the opposite direction.

Adhémar's theory is, of course, flatly opposed to the doctrine of Organic Evolution. The phenomena of life are irreconcilable with a total destruction of plants and animals every few thousand years. In short, the Adhémar theory may be held up as a warning to mathematicians who persist in rearing up imposing—in more than one sense—superstructures upon imaginary data.

SERVICES OF ANTS IN HORTICULTURE.—Dr. Lakonitz (*Humboldt*) considers that ants are beneficial to trees by protecting them from injurious insects and their larvæ. According to King, there exist, in certain plants, species of *Vicia*, *Cassia*, and *C. prusses*, *Balsamina officinalis*, *Hybiscus syriacus*, etc., extra-floral nectaries which secret sugary matter, and thus entice the ants. Lakonitz even proposes to smear the stems of trees with a solution of sugar so as to induce the ants to ascend them. (But what of the Aphides, which ants not merely protect, but even introduce into gardens and orchards, thus occasioning great damage? And what of the leaf-cutters?—*Edit.* SCIENTIFIC NEWS.)



CHLAMYDOPHORUS TRUNCATUS (A DWARF ARMADILLO).

Natural History.

A DWARF ARMADILLO.

In South America, in the stony regions of Mendoza and San Luis, and also in Chili, there lives a curious little armadillo, discovered in 1824 by Harlan. The inhabitants give this animal an assortment of names. In some parts it is called *Juan Calado* (pointed Jack) on account of its sharp snout. Elsewhere it is known as *Pichiciego* (the little blind), by reason of its resemblance in size, shape, and habits to the mole. It is known in Europe as the armour-plated mole, or the Chilian mole. Its scientific name, however, is *Chlamydophorus truncatus*, the generic name being given because it seems to carry a mantle, and the specific name because it seems truncated, that is to say, cut short at its hinder extremity.

There are armadilloes of various growths, from the giant Priodont of Paraguay, which reaches one and a half yards in length, to the "encuberto," whose dimensions do not exceed a foot. There is no species smaller than the *Chlamydophorus truncatus*, which is shown in its natural size in the accompanying illustration, taken from *La Nature*. The largest specimens do not exceed six inches.

Among the members of this family there are certainly some better armed. Many have a covering which more completely recalls the armour of imbricated plates worn by knights at tournaments. Our *Chlamydophorus* is comparatively lightly armed. Its short head, very convex behind, terminates in front in a pointed cone, covered behind by a projection of the back-plate.

All the back is covered. The body terminates abruptly, being, as it were, cut off at right angles, and is sheltered under a solid bony plate with polygonal divisions in form of a rounded shield, having in the middle of its posterior margin a notch through which issues a short tail, widened at the tip. The rest of the body is covered with a long, soft, fine, yellowish fur, with the exception of the tail, the soles of the feet, the chin, and the snout, which are bare.

The legs are short, robust, and thickset, remarkably well adapted for digging. The fore-feet especially are each armed with five enormous claws, bent backwards. The hind legs, which are weaker, have also five toes, but the claws are less strong, obtuse, straight, and flattened, whilst those of the fore-feet are in the shape of the blade of a scythe, sharp at the outer edge; they become larger and longer from the second to the outer claw, which is broad and flattened like the iron of a spade.

The dentition follows the ordinary type of an armadillo; there are eight to ten pairs of teeth in each jaw; no incisors and no canines. The molars, completely cased in enamel, have no roots, and are hollow in their lower part. The middle tooth in each row is the largest, while the others decrease towards both ends. The mouth is very small, and opens beneath an acute, cartilaginous muzzle, resembling in miniature the snout of a pig. It does not even reach to the line of the eye, and is bounded by projecting lips, almost of a leathery texture. The tongue is long and fleshy.

The armour of the *Chlamydophorus* is of a horny consistence, of a whitish or yellow colour, moderately thick, and not very flexible, but the movements of flexion of the body are assisted by the manner in which the bands of the armour are joined together. Each band is connected with its neighbours by a membrane which allows of a certain extension, so that the animal can roll itself into a ball like the wood-lice. The back-armour is formed of twenty-four transverse bands, composed each of seven or eight scales, then of fifteen to seventeen, eighteen to twenty-four as we approach the posterior region, the body becoming gradually broader from the shoulders to the loins. These scales are irregular, or tuberculous in the fore-parts, but regular and rectangular in the posterior region.

The shield which covers the posterior part, forming a right angle with the rest of the body, is quite inflexible. It consists of five or six concentric ranks of pieces arranged in a semi-circle, each of these small shields being square or lozenge-shaped. The upper and largest range consists of twenty scales; the last and smallest only of six. The entire shield is connected with the pelvis, firmly soldered to its apophyses, but the back-plate does not adhere so firmly to the back of the animal. It lies free, and is only linked by a membrane to the spinous apophyses of the vertebral column at its middle. The frontal region of the back-plate is firmly soldered to the skull, and more backwards the plates are fixed by two scales to warty projections above the eyes. The immovable portion of the head-armour is formed of two transverse rows of four plates each, and of three others of five plates.

The eyes of the *Chlamydophorus* are very small, and partly covered by the hair of the face. There are no external ears; the auditory passage opens into a narrow orifice surrounded by a fold of skin.

The habits of this animal are not yet known with accuracy. Without doubt it subsists, like the rest of the family, on insects and worms, possibly also on roots and bulbs. It is nocturnal, selecting desert and uncultivated places.

According to Goering, the track of this singular animal is characteristic. In walking it trails its feet instead of lifting them, and thus traces in the sand two continuous furrows, which are easy to recognise. The entrance of its burrow is peculiar; on going forth it throws the soil which inconveniences it to the right and the left, thus forming on each side two little mounds, with a hollow between them.

The *Chlamydophorus* is far from common, and is not sought after by the natives.

The skeleton of this animal presents remarkable characters. Its general character is uncommon vigour, the pelvis is strongly built, the limbs firmly constructed, the flattened bones of the thigh and of the upper arm testify by the strength of the apophyses of insertion to the power of the muscles by which they are moved. This remarkable genus differs in many points from the normal armadillos.

Oscar Schmidt thinks that *Chlamydophorus* must have branched off from *Dasypus* as far back as the tertiary epoch.

Vogt remarks that in certain respects this tiny being approaches more closely than any other surviving species to the fossil megatherium.

Mosquito Bites.—According to the *Mail and Express*, a strong solution of cocaine will stop the irritation of mosquito-bites, and prevent swelling. This discovery is very well, but something to render the human body offensive to mosquitos and sand-flies would be still better.

Fight Between a Leopard and a Bear.—A curious incident has just occurred at Darjeeling in connection with a leopard. It was known to be an exceptionally savage beast, and about six weeks ago killed two mules and a pony within half a mile of our garden. The other day my men found a bear which had been killed and half eaten by it. There must have been a tremendous fight, and the animals appear to have rolled together in their struggles fifteen or twenty feet down through the forest. I was not well enough to go out, but lent my gun to a native to sit up in the evening over the remains of the carcase, consisting of the hind legs. The men returned when it got dark, having seen nothing, but during the night the leopard came back and finished off everything except the skin. It measures over five feet, not a very big one, but quite up to the average, and a real black bear.

The Life of an Eel.—M. Desmarest gives in the *Naturaliste* (reproduced thence in *Humboldt*) an account of an eel which lived in his family from 1829 to 1869. Its life was passed under unfavourable circumstances. It was kept in an earthen pan, in which it had to lie coiled up, the water being changed twice weekly. Since 1852 it was placed in summer in a roomy zinc tank, but was returned to the earthen pan in winter. Twice it was completely frozen up, in the winters of 1851-1852 and again in 1864, but sustained no injury. It was fed with small bits of meat, but only in the summer. The fish seemed to know its keepers, and raised its head slightly up out of the water if it wanted food, or if it was called. In the summer of 1869, during very hot weather, it contrived to escape from its tank, and was so scorched by the sun that it perished. In spite of its age, its weight was only about 2 lbs. 3 ozs.

Spring Flowers.—Dr. J. E. Taylor, referring to the fact that these plants have a tendency to flower before they come in leaf, suggests that this early flowering tendency is a survival of a habit which the plants formerly had to blossom under more vigorous conditions of climate. He thinks that our spring flora has survived through its ability to bloom at an early period of the year at low levels, while flowering later at higher altitudes.

Appearance of the Swallow.—The first swallow of the season, says *La Nature*, was seen on March 30th, near the Pont Neuf.

SCALE INSECTS.

IF we look carefully at the plants in a greenhouse, we shall very likely see here and there upon the leaves or branches a little cottony tuft, too minute to attract the attention of an incurious eye. With a needle or sharp penknife the mass may be scraped off, and put upon a slip of glass. If we add a large drop of absolute alcohol, the cottony threads become indistinct, and soon disappear. This at once proves that they are not really cotton, nor indeed hairs of any kind. Before the fluid has time to evaporate, we may lay a cover glass upon it, and examine under a microscope. If the specimen be taken during the early months of the year, we shall see a great number of very small insects—six-legged, without wings, not very unlike cockroaches, but say ten thousand times as small. They are the larvæ of a scale insect.

White, in the "Natural History of Selborne" (Letter 97), describes carefully a similar insect which infests the vine. He speaks of husky shells enclosing a cotton-like substance, in which multitudes of eggs were entangled, and quotes a correspondent who tells of a vine suddenly overspread by large lumps of a clammy fibrous substance, resembling spiders' webs or rather raw cotton. It was pulled off by handfuls, but could not be cleared away. The grapes never filled to their natural perfection, but turned watery and vapid.

Scale insects are too familiar to the gardener to excite his interest. If you talk to him about their habits, it may be that he will lose temper, and the most sympathetic remark which you can expect will relate to some method of destroying them. To the naturalist, however, these insects are a most curious study. Their mode of life, and the light which they throw upon other insects of great economic importance, justify a careful examination.

The scale insects are distantly related to the greenfly or aphis, also a pest in its way, and more closely to the phylloxera of the vine. This does not in the least redeem their character. It is perhaps more to the point to say that they are first cousins of the cochineal insect, the lac insect, the wax insect, and the kermes—creatures of commercial and historical interest. Kermes yields the principal scarlet and crimson dyes of the ancients—the scarlet and crimson of the Old Testament. The lac insect provides us with shellac, and also with a red dye much used in eastern countries. Cochineal is still of great commercial value, and until azo scarlets had been extracted from coal-tar, it held the first place among red dyes. Carmine is a preparation of cochineal.

In all these insects the mode of life is generally similar. The larva escapes from the egg, feeds and grows, gaining the shelter which it needs either beneath the body of its mother or among the cottony tufts which she has prepared. In the warm season it runs about for a short time over the tree, chooses for itself a convenient lodging, and then thrusts its proboscis into the bark. After this, in many cases, it moves no more. It feeds upon the juices of the tree, and produces its eggs on the same spot where it has lived during a great part of its own life. Sometimes it becomes as it were inflated into a balloon, lodging its young ones apparently within, but really beneath its body. This is the case with the kermes. Other scale insects, like that so common in greenhouses, exude from their bodies the cottony filaments which serve as a nest for the young. The male is a rover. He has no proboscis, never settles, and never feeds, but he has a pair of large gauzy wings, which enable him to pay his court to the sedentary female.

We have seen that the cottony threads dissolve in alcohol. They are really filaments of wax, squeezed out from pores in the body of the female, by a process not unlike the exudation of wax in a bee. A few scale-insects, such as the wax insect of China, shape these waxy filaments into cells, within which their larvæ dwell comfortably. Whether the wax is of animal or of vegetable origin may be a question. Many plants produce it in abundance, as a delicate bloom upon the leaves or fruit. The wax palm even secretes it in quantities which are commercially available. These facts suggest that the scale insect merely appropriates a substance ready-made in the sap of the tree. On the other side we have the experiments of Dumas and Milne-Edwards, which tell us that bees, fed upon pure sugar, were nevertheless able to continue the secretion of wax.

Several scale insects, among which the chief are

cochineal, lac and kermes, contain a red fluid, of which carminic acid appears to be the essential ingredient. Carminic acid has also been found (by Sorby) in an aphis of the apple-tree. If we ask what purpose this red substance serves in the case of these few insects, and why it is found in them alone, a partial answer can be given. Kuhlmann showed some time ago that cochineal has the same oxygen-carrying property as hæmoglobin. When added to a reducing agent, such as ammonium sulphide, hydrated oxide of iron, or zinc and sulphuric acid, it loses its colour, but regains it on shaking up with air, and the process may be repeated indefinitely. Now, hæmoglobin itself occurs in one insect, the aquatic larva of the gnat-like chironomus. A red fluid, probably of respiratory function, exists therefore in these insects, and so far as is known, in none beside.* If we wish to clear up the function of what we are now entitled to call the respiratory pigment of the scale-insects, we must ascertain what the insects which possess it have in common as to mode of life, and look out for some peculiar habit, or environment, which demands an oxygen-carrier in their lymph. Some time ago, SCIENTIFIC NEWS, Vol. i., p. 129 (first series), we pointed out, by means of a general survey of the animal kingdom, that an oxygen-carrier is specially required by animals which have a limited respiratory surface, and among others, by such as dwell in burrows or confined situations. Now, chironomus is a tube-dweller, living in a burrow made by itself out of vegetable refuse. The scale-insects are protected as larvæ either beneath the body of the mother or in a house, cell, or nest made by her. As adults their body is dense, and mainly serves as a roof to the young brood. The difficulty of getting a good supply of air to the internal tissues of the body which these conditions seem likely to occasion, is independently evinced by the fact, long ago established by Leydig, that scale-insects possess two pairs of long air-tubes, which project beyond the walls of their temporary habitation. So far all is consistent, and we can give some shadow of a reason why chironomus and certain scale-insects should differ from other insects, and resemble the earthworm, as well as nearly all vertebrates, in the possession of a respiratory pigment. The aphis of the apple-tree still remains unexplained. As to this insect and its mode of life, adequate information is not accessible to us. But the analogy of other forms of life renders it hardly unsafe to conjecture that when its natural history is fully cleared up, we shall find that this too, by reason possibly of some obstruction to free breathing over the whole surface of its body, stands in special need of the respiratory pigment which it undoubtedly possesses. It is to the parasitic and sedentary habits of the scale-insects that we owe the properties which make certain of them commercially valuable, and it is worth while to study our unproductive and noxious native species, if only to understand a little better how the red dyes of cochineal, lac and kermes, the insect wax of China, and the shellac of which we make sealing-wax, marine glue and lacquer, are severally produced.

ACTION OF FORESTS ON RAINFALL. — Mr. Ganett, writing in *Science*, maintains that neither planting nor denudation exerts any constant influence upon rainfall.

* The head of the housefly contains a red fluid, which is believed *not* to be hæmoglobin, nor to contain carminic acid.

THE LICK OBSERVATORY OF THE UNIVERSITY OF CALIFORNIA.—II.

(*Concluded from page* 364.)

IT is interesting to compare this telescope with the simple instrument made by Galileo in 1609, consisting of a single leaden tube with a plano-convex lens at one end for an object-glass, and a plano-concave lens at the other end for an eye-piece, and magnifying three times. Ever since Galileo's brilliant discoveries with this "optick tube," described by Milton in his visit to Padua, the growth of the telescope has been of steady progress, in spite of the opinion of a contemporary profession of Galileo in the University of Padua, who argued that things invisible to the naked eye are useless and do not exist." In tracing its development briefly we find that the difficulties in obtaining good glass led Newton to construct a reflecting telescope in 1688, which magnified thirty-nine times, the speculum or mirror being made of an alloy of copper and tin. Improvements followed, which finally resulted in Herschell's finely-constructed instruments, in the large six-foot reflector in its gigantic frame, made by Lord Rosse, and in the celebrated reflectors of the present time. The reflecting continued to supplant the refracting telescope until about 1753, when Dolland, an English optician, showed that lenses of flint and crown glass could be combined in such a manner that their dispersive powers would neutralise each other, and this is the principle of construction of the achromatic objective now in use, consisting of an outer double convex lens of crown glass and an inner lens nearly plano-concave of flint glass.

The twelve-inch refractor, which was originally made for Dr. Henry Draper's private observatory at Hastings, N.Y., by Alvan Clark and Sons, is of the finest construction. The object-glass of the 6½-inch equatorial was also made by the Clarks, and is provided with a portable mounting, made by Warner and Swasey. The four-inch comet-seeker, made by Alvan Clark and Sons, has a focal length of thirty-three inches.

The photoheliograph is mounted south of the transit house. The transit instrument determines the axis of the photoheliograph, and this is also used as a collimator for the transit. The six-inch Repsold meridian circle was delivered in 1884, after having been inspected by Professors Auwers and Krueger, of Berlin. The declinograph was made under the supervision of Dr. Johann Palisa, of Vienna, to fit either a twelve-inch or six-inch equatorial. The universal instrument made by Repsold consists of a telescope containing a prism, into which the rays of light are reflected. Its aperture is 2·15 inch. The horizontal circle reads by two microscopes to 2″, and the circles are ten inches in diameter. This is a perfect geodetic instrument, and, together with a six-inch equatorial and a chronometer, can be easily packed for astronomical expeditions. There are several chronometers made by Negus, and a thermometric chronometer by C. Frodsham. The most important of the minor instruments are the filar micrometer for the thirty-six inch telescope by Fauth and Co., the duplex micrometer by Grubb, and a star spectroscope made by Brashear, from Mr. Keeler's designs. Plans for a large solar spectroscope are being worked out by Professor Holden and Professor Langley. The other instruments are a delicate sphereometer by Fauth and Co.; resistance coils; galvanometers; a disk photometer; spectroscopes; a lever-tester of refined construction; and an engine for

measuring photographs, scales, etc., made by Stackpole and Brothers, from the designs of Professor Harkness.

The meteorological instruments are: Self-registering rain gauges, wind gauges, barometers, and a number of thermometers. There is a complete set of apparatus for registering earthquakes, provided by the Cambridge Scientific Instrument Co., consisting of a horizontal seismograph, with clock and driving plate, the clock being started by an electric contact at the beginning of a shock, the two rectangular components of the horizontal motion then registering on a moving plate; a vertical seismograph to register vertical motions on a dial plate; a duplex pendulum seismograph to give independent records on a dial plate, the pencil being free to move in any azimuth; and a chronograph, which is set in motion at the beginning of an earthquake, and records its duration upon a clock.

The staff of the observatory consists of Prof. Edward S. Holden, director and chief astronomer; Samuel W. Burnham, James E. Keeler, John M. Schaeberle, and Edward E. Barnard, assistant astronomers; and C. B. Hill, secretary, librarian, and occasional observer.

Early in 1886, Prof. Holden made contracts with the Southern Pacific and other railroad companies for supplying time from the observatory by automatic electric signals. This regular time service, of which Mr. Keeler has charge, has been in operation since January, 1887. A great part of the apparatus used in this service forms an integral part of the observatory's equipment. The system which has thus been introduced has been of great service to that particular section of the country, as well as to the railroad companies.

Instruments for recording earthquake shocks have been constructed by a company in San Francisco, and are sold at a very low figure. It is designed in this way, that records of any seismic movements shall be procured by private individuals in different parts of the State, and plates upon which the movements have been recorded may be sent to the observatory, where a record will be kept of all such data, and blue prints will be made of the diagrams and copies of them sent to the person from whom the plate has been obtained. Although this is quite independent of the regular work of the observatory, it will doubtless lead to the accumulation of data which will be most important in formulating statistics for future use.

The great telescope has been mounted for several weeks, and several satisfactory tests of its capacity have been made. It was first directed to the sky on the evening of January 3rd, 1888, and a few observations were then made for the partial adjustment of the object glass, but the observation was abbreviated by the skies becoming cloudy. The next observations made were on the evening of the 7th. On this occasion Saturn was observed, and Mr. Keeler who conducted the observation, says with rapture that it was "the most glorious telescopic spectacle ever beheld." He exclaims: "Not only was he shining with the brilliancy due to the great size of the objective, but the minutest details of his surface were visible with wonderful distinctness."

The outlines of the rings were very sharply defined. The most curious feature was the structure of the outer ring; at about one-fifth of its width from its outer edge, a fine dark line was discernable, which marked the beginning of the dark shading, diminishing in intensity up to the black line. The inner ring did not shade off gradually into the crape ring, as often represented, but the line of separation was distinct. The space between its inner edge and the planet was perfectly black.

Much of the data given in this article was procured from Prof. Holden's report in the *Sidereal Messenger*, and Mr. James E. Keeler's notes on his own observations in the same journal. The observatory with its apparatus and appurtenances is to be transferred, upon its completion, to the University of California, and will in future be under the government of the regents of that institution. Prof. Holden resigned the presidency of the University in order to become director of the observatory.—*Scientific American*.

Reviews.

The Testing of Materials of Construction: A Text-book for the Engineering Laboratory and a Collection of the Results of Experiment. By William Cawthorne Unwin, F.R.S., M.Inst.C.E., etc. London: Longmans, Green and Co. Price 21s.

There are few of us who would not claim that this country is ahead of all others in constructive engineering of all kinds, and were the question to be settled by work accomplished, it would be difficult to come to any other conclusion; it is, therefore, humiliating to find that for information as to the strength of the materials our engineers use so skilfully, we have largely to depend on experiments and tests made in Germany and America, in default of sufficiently extensive researches made in this country. Such, however, is the conclusion forced upon us by reading Professor Unwin's work on the subject, and it is a condition of affairs not likely to improve, as there is little chance of the establishment of testing laboratories in this country, supported by Government on such a scale as those of Berlin and Munich, or the later establishment at Watertown, U.S.

We are becoming accustomed to the minuteness and delicacy of measurement, and elaboration of method on the part of German scientists in all classes of investigation; though we are inclined to agree with the author's suggestion that possibly these investigations are often pushed beyond practical needs; but at the first glance it appears like a grim kind of jest to be referred to America for reliable data on strength of materials, in the face of the disasters that are constantly reported in the papers as taking place on American railroads owing to defective bridge construction. However, we may rest assured that Professor Unwin would not have gone so far afield for his information without good cause, and can only express our regret that he has not given us the results of more of his own researches in this direction, instead of modestly confining his own contributions to the filling up of gaps left in the investigations of others. The above remarks refer more particularly to the latter portion of the work under consideration. In the earlier portion Professor Unwin thoroughly explains the mechanical properties of bodies acted on by stresses, and their determination by formulæ. The stress-strain diagrams obtained by various autographic apparatus, invented by the author and others, are most impressive records of experiments, and appeal far more rapidly and forcibly to the eye, and therefore to the mind, than columns of figures, and must be of immense assistance to the investigators in winnowing out the grains of results from the vast piles of experimental chaff. The value of this book is considerably increased by the description,

in the second portion, of all the principal testing and recording instruments, carefully and excellently illustrated, now in use in the chief engineering laboratories; and we can heartily congratulate Professor Unwin on the completeness and care with which it is evident this volume has been produced. It will undoubtedly take a prominent place among the standard works on constructive engineering.

Elementary Chemistry, Inorganic and Organic. Adapted to the Requirements of the "Alternative Elementary Syllabus" of the Science and Art Department. By W. S. Furneaux, F.R.G.S, Science Demonstrator, London School Board. London: Longmans, Green and Co.

Works like the one before us are apt to suggest certain difficult questions. How is it, for instance, that so many elementary chemical treatises appear differing from each other little, if at all, as far as the subject matter is concerned? What can be the *raison d'être* of three-fourths of them? How is it that they can always find publishers? How is it that, unlike German manuals of chemistry or of any other science, they are, with few exceptions, "adapted" to some examination or "syllabus"?

Mr. Furneaux hopes that his work may be a useful introduction to the study of other sciences, many of the facts and principles of which cannot be properly grasped by a mind totally ignorant of chemistry. He avoids, as far as possible, technical language. He informs the pupil how to perform certain experiments, for the most part very simple, and shows him what inferences are to be drawn from the results.

In speaking of the atmosphere, he makes, of course inadvertently, a strange inversion. We read that nitrogen "forms one-fifth of air and supports combustion," whilst oxygen "forms four-fifths of the air and does not support combustion." There are other passages in the book from which the true properties of these gases appear, but we fear that the statement quoted may perplex beginners.

In proof of the proposition that when a substance burns it increases in weight, we find directed an experiment which does not seem judicious. Says the author:—"Balance some iron-powder *(ferrum vidactum* should be *reductum)* on a pan of a delicate pair of scales, and cause it to burn by applying heat. As the iron burns it combines with oxygen of the air, and the increase in the weight of the pan will be proved by the falling of the pan containing it." The application of heat to any substance in the pan of a "delicate" balance, and that, moreover, whilst the pan is still in suspension, seems a hazardous and unwise proceeding. Experienced chemists never place any substance on the pan of the balance until it has been cooled down to the temperature of the air.

In speaking of the substances obtained from coal, Mr. Furneaux writes:—"The beautiful aniline colours are produced by the distillation of tar." This is surely an unhappy way of explaining the origin of the coal-tar colours. Mere distillation, even if fractionated, would never yield these dyes. There are a few other errors and some repetitions, but in general we may say that the book will be useful for those who wish to acquire an elementary knowledge of chemistry. In how far it may suit students "preparing for examinations" we are unable to say.

Transactions of the Manchester Geological Society. Vol. xix., Parts 16 and 17.

In the former of these numbers we find "Observations on Boulders from the High Level Drift of Bacup," by Mr. Herbert Bolton. The boulders in question are of volcanic origin, apparently derived from the English Lake District. Indeed, a closer examination has enabled the author to identify these boulders with rocks in the localities from which they have been carried. He considers that three well-defined beds of glacial drift may be traced in the Bacup area.

Reference was made to the views of Mr. Carrill Lewis, who had found at Bacup the moraine of a great glacier, which chocked up the Irish Sea, and which may be traced through Bacup, Hey, Stalybridge, Stockport, and Macclesfield, being as finely developed as the moraines of Switzerland and America. He considers that at Manchester the ice was at least 1,400 feet thick. Professor Boyd Dawkens controverted the views of Mr. Carrill Lewis as not in harmony with facts.

Two papers on "Boulders in Coal Seams" were communicated by Mr. Cowburn and Mr. Sterrup, to which we hope to refer elsewhere.

In No. 17 is noticed a short paper of Mr. C. Handwick on the "Granite of the Mullett, Ireland," illustrated by specimens and by a picture of the rocks taken by Mr. Robert Pollitt.

Journal of the Society of Telegraph Engineers and Electricians. Vol. xvii., No. 71.

This issue comprises a very important paper by Mr. Gisbert Kagog on "Alternate Current Transformers, with special reference to the best proportion between Iron and Copper." Concerning the distribution of electric energy to consumers, the speaker remarked that of the three methods in practical use, "our own is the worst, the American slightly better, and the Continental the best." "To string high-tension wires over and across our streets, allow high tension branch-leads to pass into our houses, and give every subscriber a little transformer to himself, more or less within the reach of the inmates, seems to me to be positively courting disaster." Also a paper read by Mr. J. Kenneth Mackenzie on the "Distribution of Electricity by means of Secondary Generators or Transformers," and Mr. Gisbert Kagog gave an abstract of a communication by Prof. G. Forbes, entitled "Formulæ for Converters."

EXAMINERS AND CANDIDATES.

IT has been the writer's fortune to sit at several examinations, and to set a good many examination papers. Perhaps some hints of what he has learned by experience may interest the very numerous people who belong either to the class of examiners or to that of candidates.

Since the ways of the examiner govern the ways of the candidate, it will be best to look at the subject, in the first place, from the examiner's point of view. It is generally an easy and not unpleasant business to set the paper. The exercise of devising questions which give a new air to familiar facts, and the power of directing a good many men's thoughts for some few hours at least in a channel of his own, is a gentle stimulus to the examiner's mind. He does not realise for a good while how difficult it is to be just to all parties, and when he

has gained experience, it is not without pain that he looks back to his own early performances, only to find pedantry in one question, obscurity in another, and want of balance throughout. The rules which an examiner, bent upon self-improvement, will arrive at are such as these: (1) That it is his duty to ascertain the knowledge, and not the ignorance, of the candidates. Truly it is a mean thing for the grown man, strong in the facts and theories which he has expounded for years, to set pitfalls for students in order that they may stumble and fall. (2) That an important question should never turn upon the meaning of a new technical term. The teacher may have used another word, and the candidate will then have nothing to say about a topic with which he could have dealt effectively had the question been differently phrased. (3) That an examiner must take pride in his equity and moderation, never in his learning or ingenuity.

It is not superfluous to advise an examiner to keep copies of his old papers, and look at them now and then. Otherwise he may repeat himself too often. One examiner might be named who never sets a paper on elementary chemistry without bringing in the flame of a candle. Very likely it pleases him to observe how successfully that interesting theme is handled by a very large proportion of the candidates.

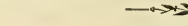
Let us suppose the paper set and answered. Then comes the looking over of the answers, a long and hateful job. The just examiner will now find how laborious and depressing is his task. He must put himself upon his honour, and resolve to take no thought for his own comfort or ease. The work can only be done well by breaking it up into a number of separate bits, each in itself perfectly simple. First assign marks to each question. Don't attempt, as so many examiners do, to coax the marks, until the total amounts to exactly 100. It is far better to assign the marks without more than a general reference to the total, and afterwards rectify the figures by the method explained below. Then consider each question by itself. Set down on paper the points which ought to be included in the answers. Assign marks to each. Break up the chief heads into minor points, if you can. When you have done, reconsider the values of the questions. Take a preliminary glance at the questions, to see whether your scale will work out well. Then reduce your figures to the exact proportion which they ought to bear to a total of 100. The Harrow mark-reducer or a common slide-rule does this in a minute or two. Work through the whole pile of papers, question by question, and afterwards look rapidly over each set, adding marks for intelligence, accuracy, good method, etc., or deducting for the opposite qualities. Do this before you have cast up the totals. Never alter the totals on account of anything you may independently know of the candidates, such as that on a previous occasion you had placed them differently. The total should be carefully arrived at, and treated with a good deal of respect. Underlining mistakes and defects all the way through is a necessary precaution against the bitterness which is so apt to creep over the depressed examiner. It is not a bad plan to use a red and blue pencil. One colour may be used for mistakes of fact, the other for faults in arrangement or style.

A conscientious examiner will now and then examine himself, arranging in order of merit a set of papers without putting a single mark on the papers themselves, laying them aside for a month, and then doing it all over again, in order to get an independent result. The correspondence expected varies with the subject. For arithmetical and many kinds of mathematical papers, variations of 5 per cent. in the totals should cause surprise. Where the papers are descriptive, 10 per cent. of variation is not unusual. Of course no practical effect should be given to differences within the probable error of the marker. Many examiners affect an impossible accuracy, and assign places on the ground of differences in marking amounting only to 1 or 2 per cent.

Now for the candidate and his share of the work. The common faults, besides those due to mere ignorance, are complete misunderstanding of the question, careless errors in matters of fact, and defective method. The remedies are great attention to the questions before beginning to write, and the drafting of skeleton answers. The candidate may be recommended never to begin until he has carefully studied the whole paper, and never to attempt a complicated question without writing down the heads of his answer. It is of the highest value to practise this beforehand. Précis of a lecture instead of verbatim notes, abstracts of authors read, skeletons of original essays are all first rate practice, not only for examinations, but for much of the serious occupation of after life. Every answer should be read quietly over before leaving it. No time is wasted which tends to better arrangement or more complete statement. As a rule, it is best not to attempt all the questions, and to do first the hardest of those which can be answered completely and well. Candidates are often curious to know "whether it pays to make shots," and the general belief is in favour of the practice, but it is impossible to calculate chances. Some examiners are indulgent towards foolish and blundering answers, and only take note of positive knowledge. Others are stricter, and deduct heavily where they see signs of mere guessing. A really good candidate never even discusses these doubtful ways.

There are of course the widest differences, not only in examiners, but in examinations. In a pass examination the main object is usually to find out what a candidate knows. In a scholarship examination the main object is often to find out what sort of fellow he is, and many of the tests are modified accordingly. A considerable range of imperfect, ill-digested knowledge may get a man through a pass examination. It counts almost for nothing in a scholarship examination where there is a good field of candidates.

The outcome of the whole discussion is that examination is pre-eminently a field in which method and commonsense tell. Speed is important, but probably overrated by the candidate, except in the few cases where it comes of a full, accurate, and ready mind. Cleverness in "dodges" does no good, except where the examiner in phenomenally stupid. Evasion of the point of a question brings no luck. At best, it leads the examiner to attribute to stupidity what really belongs to ignorance. It is well for the candidate if the plainness of his handwriting and the clearness of his arrangement help to keep the examiner in good temper.



Fermentation under the Action of the Elliptical Ferment.—M. G. Jacquemin (*Comptes Rendus*) has proved experimentally that *Saccharomyces ellipsoideus* is a true, stable ferment, quite distinct from beer yeast, and that it converts saccharine solutions, decoctions of malt, etc., into true wines, not to be confounded with beer.

Abstracts of Papers, Lectures, etc.

ROYAL INSTITUTION.

The evening lecture on April 13th was given by Professor Flower, C.B., F.R.S., on "The Pygmy Races of Men." Various classical authors—Homer, Herodotus, Aristotle, Ctesias, Pliny, and others—were cited to show the widespread belief in the existence of races of human beings of exceedingly diminutive stature, and to which the name of Pygmy was given. Extension of knowledge of the natural products of the earth and a more critical spirit on the part of authors led to attempts to explain this belief, and the discovery of races of monkeys, of the doings of which more or less fabulous stories were often reported by travellers, generally sufficed the commentators and naturalists of the last century for this purpose. Recently acquired information as to the actual condition of the human population of the globe has, however, led to a revision of the ideas upon the subject, and M. de Quatrefages, the eminent professor of anthropology at Paris, has especially examined and collated with the greatest care all the evidence bearing upon the question, and devoted much ingenuity to prove that the two localities in which the ancient authors appear to place their Pygmies—the interior of Africa and the southernmost parts of Asia—and the characters they assign to them indicate an actual knowledge of the existence of the two groups of small people who still inhabit those regions, and whose history formed the subject of the lecture. It is still, however, an open question whether these old stories may not be classed, with innumerable others, as the offspring of the fertile invention of the human brain, the potency of which as an origin of myths is sometimes too much underrated. Taking leave, therefore, of the legendary stories, the remainder of the lecture was devoted to an account of our actual knowledge of the smallest races of men which exist, or, as far as we know, ever have existed on earth, and which, taking the word in its current though not its literal sense, may be called Pygmies, or folks no bigger than one's fist or fore-arm. The Andaman Islands in the Indian Ocean are inhabited by a race of great interest to the anthropologist. The earliest notices of these islands are contained in the accounts of Arab voyages of the ninth century, the ferocious hostility of the inhabitants to all strangers and their reputed cannibalism being described in glowing colours. It is to this character that they owe their long isolation, although situated close to the track of a great commercial navigation. In 1788 the English Government of Bengal attempted to establish a penal colony on the islands, but it was abandoned a few years later, and the natives were left to themselves until 1857, when the project was revived with greater success and a settlement formed, at which upwards of 12,000 convicts from the mainland of India are now maintained. The natives at first were very shy, and it was some years before amicable relations were established with them; but now, owing to the judicious and considerate treatment of successive English governors, they have laid aside their former reserve, not to say hostility, and much information has been collected, exhibiting their moral character and social condition in a much more favourable light than the earlier accounts led us to believe. They do not cultivate the ground or keep domestic animals, but they have a rude kind of hand-made pottery, and make vessels for holding water out of the hollow stems of bamboos; they also make excellent fishing nets and baskets. They are perfect swimmers and divers and expert at managing canoes. Their principal weapon is the bow and arrow, but they also use spears, harpoons, etc. They have no metals, and appear not to know how to produce fire, though they always preserve it carefully, as they rarely eat any food which is not cooked. They live chiefly on wild pigs, birds, turtles, fish, wild fruits, roots and seeds, larvæ of insects, and honey, and drink nothing but water. There is no trustworthy evidence that they are, or ever have been, cannibals. The valuable information collected about these people by Mr. E. H. Man refers, of course, to their condition before their contact with European civilisation. Now all is changing, it may be feared not for the better, and as a race they are fast disappearing. One of the most distinctive physical features of the Andamanese is their diminutive size. Accurate measurements of a large number have been made, showing that the average height of the men is 4 ft. 9 in.; that of the women 4 ft. 6in. The colour of their skin is dark, almost black, their hair is exceedingly closely curled or "frizzly," and their heads are of the short, round type. The great interest of the Andamanese natives is that they are the only remaining pure specimens of a race of small stature, dark colour, and frizzly hair which appear to have been the earliest inhabitants of a large part of Southern Asia, including India, Siam, Cochin China, and all the islands of the Indo-Malayan Archipelago—a race to which the name of Negrito has been given. Traces of these people are still found at various spots over this area, as in the Philippine Islands and the Malay Peninsula, but always occupying the most mountainous and inaccessible regions, and more or less persecuted by the later comers, who have occupied the more fertile portions of their land. In most cases their original characters are changed or nearly lost by a mixture with other races, but just enough remain to indicate their former existence. Passing to the continent of Africa, we find in the southernmost parts the well-known Bosjesmen, or bushmen, exhibiting a very peculiar modification of the Negro type. Their average height is very much the same as that of the Andamanese, and they have the same very crisply curled, short, black hair, but in many other respects they are widely different. Separated from them, both geographically and in physical characters, are a peculiar race of very little people called by Hamy Negrillos, who are found living in scattered communities among those of the ordinary full-sized Negroes nearly all across the continent of Africa, within a few degrees of either side of the Equator. Unless these were the real Pygmies of the Greeks, our first knowledge of them is due to Andrew Battell, in his interesting and apparently truthful description of the Loango coast, written in the end of the 16th century. His accounts were corroborated by Du Chaillu, Stanley, and others. To this group of people belong the Akkas, who live a short distance to the west of Lake Albert Nyanza, discovered by Schweinfurth in 1870, and more recently investigated by Emin Pasha, from whose letters some extracts were read by the lecturer. These appeared to be really the smallest race known, full-grown men and women being often not more than 4 ft. high. Though so small in stature, they are active and courageous, great hunters of elephants, and use the bow and arrows with the same dexterity as their cousins, the Negritos of Asia. It is

surprising that they have contrived to maintain their independent existence, though probably in gradually diminishing numbers, in the midst of powerful tribes of larger stature; for all the existing evidence points to their being the descendants of the earliest inhabitants of the continent of which we have any knowledge. Our information about them is, however, at present very scanty, and a fuller investigation into their characters, habits, customs, traditions, and language would well repay the labour spent upon it. This subject the lecturer concluded by recommending to the serious attention of future African explorers.

ROYAL SOCIETY.

At the meeting on April 19th, Mr. C. V. Boys read a paper on the "Radio-Micrometer." The author gave the result of a mathematical investigation made with a view to arrive at the best possible construction of the radio-micrometer, already described by him. At the conclusion of the meeting he showed, in action, an instrument which he had made, having the best proportions, which was both simple in construction and far more sensitive than the one he exhibited on a previous occasion.

GEOLOGICAL SOCIETY OF LONDON.

At the meeting on April 11th, Mr. W. T. Blanford, LL.D., F.R.S., President, in the chair, the following communications were read:—

1. "On the Lower Beds of the Upper Cretaceous Series in Lincolnshire and Yorkshire." By W. Hill, Esq., F.G.S.

The red chalk which forms the basement-bed of the Upper Cretaceous in Lincolnshire and Yorkshire is a continuation of the Hunstanton limestone. Its thickness increases in South Lincolnshire, to thin away again in the north of that county; but it again increases north of the Humber for a while. Near its most north-westerly exposure on the Yorkshire Wolds the red colour is lost; but *Inoceramus sulcatus* and *Belemnites mininus* are found in a dirty yellow-coloured material of trifling thickness. Eastwards it regains its red colour and thickness, so as to be upwards of thirty feet at Speeton, where also it is less calcareous. This section was described in detail, and the results compared with those of other writers. The author speculated upon the probable limits of the Upper Cretaceous sea at this period on evidence mainly based upon the amount of matter of inorganic origin. He noted that *Am. interruptus* has been found at Withcall, *Am. rostratus* at South Cave, and *Am. auritus* (?) at Wharram Grange.

The base of the Chalk Marl through Lincolnshire continues to be marked by a bed of compact limestone, which is the representative of the "sponge-bed" of Hunstanton. This can also be traced in Yorkshire as far as the north-western extremity of the Wolds. Above this a few feet of grey gritty chalk retain the character of the "*Inoceramus*-bed" throughout the area above mentioned. At the north-western extremity of the Wolds the main mass of the Chalk Marl has diminished in thickness, but more than recovers this at Speeton, where, according to the chemical and microscopical evidence, there is a complete passage from the "Gault" to the "Chalk Marl." The peculiar development of the latter at Speeton was very fully described. No bed, such as the Cambridge Greensand or the Chloritic Marl, can be taken as a line of separation.

Throughout Lincolnshire and Yorkshire certain courses of grey-coloured chalk are recognisable on the horizon of the Totternhoe Stone: these are known collectively as the "Grey bed." Much comminuted shell and numerous Pectens characterise this bed, which is faintly recognisable even at Speeton. The "Grey bed" determines the upper limit of the Chalk Marl. The equivalents of the Grey Chalk vary less in thickness throughout the area than those already described. Certain lithological characters, which first begin to manifest themselves in the marly beds just above the Totternhoe Stone in Norfolk, become greatly developed in South Lincolnshire, and throughout that county, as in Norfolk, the grey chalk is usually of a marly nature. In Lincolnshire there is much red colouration on this horizon. The occurrence of *Belemnitella plena* in Lincolnshire has been recognised. The band of bluish black clayey material in which it occurs at Barton continues throughout Yorkshire, but no Belemnite has yet been found. Allusion was made to the characteristic features towards the base of the Middle Chalk. Lists of fossils were given, and a new species of *Holaster (H. rotundus)* was described. Numerous chemical analyses and microscopic details of structure were also given.

2. "On the Cae-Gwyn Cave, North Wales." By Henry Hicks, M.D., F.R.S., F.G.S., with an Appendix by C. E. De Rance, Esq., F.G.S.

The author gave an account of the exploration of the cavern during the latter part of 1885, and during 1886-7. He considered that the results obtained during that time proved conclusively that there was no foundation for the views of those who contended that the drift which covered over the entrance and extended into the cavern was *remanié*, but they proved that the deposits which lay over the bone-earth were *in situ*, and were identical with the normal glacial deposits of the area. These deposits had once extended continuously across the valley, and the cavern (400 ft. above Ordnance Datum) had consequently been completely buried beneath them.

The cave must have been occupied by animals during the formation of the bone-earth before any of the glacial deposits now found there had accumulated, and a thick floor of stalagmite had covered this "earth" before the cavern had been subjected to water-action. This action had broken up the floor, and completely resorted the materials, and added sandy and gravelly material to the deposits; this sand and gravel had been examined by Professor Boyd Dawkins, who found that it agreed in every particular with the glacial sand and gravel occurring in the valley a little way above. The large limestone blocks in the cavern had also been evidently disturbed by water-action; they were invariably found in the lowest deposits, and were covered over by laminated clay, sand, and gravels. The author considered it certain that the caverns had been completely filled with these materials, and in the case of the Cae-Gwyn Cave they appeared to have been conveyed mainly through the entrance recently discovered under the drift. The stratification at this entrance was so marked, and could be traced so continuously inwards over the bone-earth, that there could be no doubt that this was the main entrance. There was not the slightest evidence that any portion of the material had been conveyed in through a swallow-hole, and the conditions witnessed throughout were such as to preclude any such idea.

The author quoted a report by Dr. Geikie, who considered that the wall of the cavern had given way, but

before the deposition of the glacial deposits, which were subsequently laid down against the limestone bank so as to conceal this entrance to the cavern.

In conclusion, he referred to the presence of reindeer remains in these caves, in conjunction with those of the so-called older Pleistocene mammalia, proving that these had reached the area long before the period of submergence, and evidently at an early stage in the glacial period. It was important to remember that reindeer remains had been found in the oldest river-gravels in which implements had been discovered. Man, as proved by the implements discovered, was also present at the same time with the reindeer, and it was therefore natural to suppose that he migrated into this area in company with that animal from some northern source, though this did not preclude the idea that he might also have reached this country from some eastern or southern source, perhaps even at an earlier period.

Mr. De Rance, in an appendix, confirmed Dr. Hicks's observations as to the identity of the deposits outside the cavern with those in its interior, and noted the occurrence of limestone blocks in the lower deposits, not merely at the spot where the supposed broken wall was situated, but also throughout the whole tunnel. He stated that the sand bed forming the uppermost cave-deposit resembled the sand associated with gravels in a pit 400 yards east of the cave at a slightly higher level. The drift exposed in this gravel-pit he believed to be of the same age as that of the Mostyn and Bagillt pits to the north, which were undoubtedly overlain by Upper Boulder-clay. The westerly termination of the bone-earth outside the cave had not been determined, which he regretted; but traces of bone had been found at a point five feet from the overhanging ridge of the cave.

VICTORIA INSTITUTE.

Admiral Selwyn, R.N., in a paper read before the Victoria Institute, on April 9th, described the movements of elevation and depression which had taken place on the North American Continent. Some of these movements he described as evidently sudden, as described by Darwin, others were more slow; but both caused waves of denudation whose effects were still to be seen, and their results, in the physical features of the country.

LIVERPOOL GEOLOGICAL SOCIETY.

At the meeting on April 10th Mr. C. Potter described a very interesting section of a boring at Burscough Bridge Railway Station, by Mr. E. Timmins, of Runcorn, which passed through no less than 260 feet of boulder clay before reaching the sandstone beneath. This is the deepest section of boulder clay recorded in the district.

Mr. P. Holland and Mr. E. Dickson then read a joint paper on the "Examination of Quartzites from Nills Hill, Pontesbury," showing the presence of a notable quantity of diffused carbonaceous matter in the rock. The authors regarded this matter as of organic origin, probably the remains of fucoids.

A paper by Mr. A. Norman Tate, F.I.C., followed, entitled "Some Notes on the Colouring Matter of the Mineral 'Blue John,'" in which the author discussed the results of some experiments made in his own laboratory with this beautiful Derbyshire mineral. The results seemed to show that the colouring substance, which is destroyed by heat, is of organic origin, and the author promised further investigations on the subject.

AGRICULTURAL EDUCATION AND DAIRY INSTRUCTION.—I.

Abridgement of Paper read at the Society of Arts By Mr. John Wrightson, M.R.A.C., F.C.S.

THERE are very many who consider that the best preparation for farming is a good general education conducted upon the lines usually followed in good schools. Whether classics and mathematics, or modern languages and science are to predominate may be a matter of further divergence, but the basis of business success is a sound general education. Thus Mr. Morton at once expressed himself in favour of "Schooling before Farming." As he himself put it, "the whole business of the hour, so far as he was concerned, would be to insist upon it that the preliminary schooling was by far the most important part of an agricultural or of any other education." I do not for a moment believe that Mr. Morton is antagonistic to a scientific basis for practice. Such a conclusion would be little less than an aspersion, and would be contradicted by his whole life. Still Mr. Morton thought he joined issue with me when he wrote as follows:—"Professor Wrightson says—'A perfect agricultural education should include geology, biology, engineering, drawing and architecture, chemistry, rural economy, commercial knowledge and book-keeping, law, and meteorology.' However desirable all this may be for a future professor, the young farmer certainly does not need it at all. I do not think, indeed, it would be a good thing to take him out of his father's guidance." I entirely agree with Mr. Morton, but must tell him that I was describing a perfect agricultural education, and not the education of a young farmer, which is quite a different matter. I cannot leave so respected an authority without quoting his real heartfelt opinion as expressed in this room last spring. "And I give it," says he, "for my opinion on a review of all these two-and-forty years—in the interest not of one class, but, as I firmly believe, in the interest of all—that the best possible preliminary education is needed, not merely to make the boy stronger and more capable as a future farmer, but to fit him for something else as well—if that should fail him." Mr. S. B. L. Druce, Secretary of the Farmers' Club, expressed himself similarly at the Conference on Education at the Health Exhibition. Mr. Hunter Pringle also "admires the full education given in Scotland, not exclusively with a view to agricultural pursuits. A complete classical and mathematical education, followed with two years in a commercial office." These expressions of opinion appear to me to be both wise and practical; for surely education is in the truest sense the leading out of the man, or of the mind, from its own narrow surroundings and interests. An educated man is a free man, and not a drudge, nor yet possessed with a soul-absorbing concentration on his "bread-study." With certain slight modifications, we may agree in the general proposition that school-boy days should be devoted to the acquirement of sound general education, and that the technicalities ought to be postponed to a later period.

And yet, self-evident as are many of the above conclusions, there is another view of the case upheld by many who endeavour to combine technical instruction with the ordinary educational course. It is the principle of the school farm advocated by Mr. Jenkins, and borrowed from the French system of *Ecoles pratiques d'Agriculture*, and in a less degree from the German

Landwirthschaftsschulen. The function of these establishments is to provide a continuation of general and technical education for the sons of tenant farmers and small proprietors.

Such schools as Aspatria, in Cumberland, and the King Edward's School, near Banff, are examples of schools of this nature in Great Britain; and for a certain class they have their advantages. I am, however, disposed towards Mr. Druce's view, that general education is enough burden to lay on a boy during his early years, and so far as technical education goes, I should prefer that he should enjoy a little farming and a little practice among his father's cows, and sheep, and horses during his holidays, in a thoroughly spontaneous and enjoyable manner. Absolute training in technicalities may well be put off till a later period. It would likewise be easy to show conclusively, from evidence adduced from foreign experience, that the system of mixing technical and general instruction has never been very satisfactory. In Denmark, where agricultural education has, or is supposed to have, done so much for dairy industry, practical and theoretical education are kept rigidly apart, and a system of apprenticeship on a farm, with due certificates as to general and scientific education, are the methods relied upon.

The Higher Technical Education (Landlord, Agent, Surveyor).

No one doubts for a moment that technical instruction is absolutely necessary, whether gained by long years of bitter experience, or by the pleasanter paths of apprenticeship or pupilage. This no one doubts, and it is therefore unnecessary to take up the time of the meeting by proving it. The question is—How is it best done in the particular case before us, viz., that of agriculture? Let us at once recognise the essential differences as well as resemblances in the three cases which really take up the whole agricultural field. I allude to the differences between landlords, farmers, and labourers. These three classes form, it must be allowed, a definite series, giving rise to Mr. Jenkins's classification of an upper, middle, and lower agricultural education. The division is at once natural and inevitable, and is recognised in all countries. Alike in Germany, France, and Belgium, provision is made for the higher, the intermediate, and the lower agricultural education. There is no escape from this conclusion, and the more clearly it is appreciated the less likely are we to fall into confusion. When doubt is thrown upon the value of the higher agricultural education, with its chemistry, geology, botany, physiology, political economy, forestry, and theoretical agriculture, to an honest farmer of the farmer class, the doubt is well founded, and I join with Mr. Morton heartily when he says, "the young farmer certainly does not need it at all." In this I believe Sir Thomas Dyke Acland concurs, and it has always appeared to me that much misunderstanding would be avoided if we would remember that the kind of knowledge required by legislators, landlords, commissioners, professors, great agriculturists and agents differs in important respects from the knowledge required by the ordinary tenant of from 250 to 500 acres of land; just as the knowledge required by such a tenant differs from the sort of knowledge needed by the labourer, the carter, or the shepherd. Such differences exist, and we are not responsible for them; it is nevertheless our duty to provide for them. More attention has, I admit, been bestowed upon the higher education than upon the middle and lower, and it is not difficult to account for this preference. In the first place, the points of contact between it and scientific and historical, or legal knowledge, are much more numerous. The adaptability of various soils and situations to different systems of cultivation, the theory of fertilisers, the comparative merits of different breeds of animals, the history of agricultural progress, the laws of health, the origin and propagation of disease, the planting of timber, and many others of the subjects we teach, are of evident value to the large landowner or his agent. In other cases they bring with these acquirements possibilities of rising in the world to positions of eminence, and they throw an interest around country affairs. Superimposed upon public school and university education, they complete and embellish the inner man, and are at once seen to be desirable. They assist the county member in his speech, the magistrate in his judgment, the agent in his agreements or his advice to tenants, the surveyor in his arbitrament. They are required by examining bodies such as the Surveyors' Institution, the Royal Agricultural Society, and the Highland Agricultural Society, and this alone causes them to be studied. There is, in fact, a demand for this kind of agricultural education, and the demand has been met in this country and more than met in other countries. If this were all, we should be able to prove not only the value of the instruction, but that ample means exist for obtaining such knowledge. The difficulty does not lie here. The classes interested can pay for their instruction, and it would be strange indeed if a healthy demand of this kind should not call up a supply of the article needed.

The Middle Technical Education (The Farmer or Steward).

The best preparation for a young man intending to be a farmer, is a question which I should keep separate from the best preparation for a man who will eventually preside over a number of tenants. The aims are narrower, and the objects more urgent, in the direction of immediate commercial success. Thorough business knowledge, coupled with bodily activity, manual dexterity, sharpness of eye, strong commercial instincts, strong will, acute perceptions, tact, skill, and knowledge of mankind—these are the qualities we must endeavour to cultivate. If it is objected that these qualities are as important for the landlord or the agent as for the farmer, I would observe that the cases differ chiefly in degree. The farmer must necessarily keep his attention on routine—on minutiæ—on a host of small circumstances and small transactions. He is constantly required to settle such questions as to which horse is to go into which cart, which collar has to go on to which horse; concerning petty repairs of implements, orders for oil, sack-twine, tar-line, or plough-shares. He is often called out to examine animals suffering from illness or accident; he is the final court of appeal in all cases, and must know everything that goes on upon his limited area—from the death of a fowl to the threshing of a wheat rick. The other case is different. The issues are larger and the duties rather those of direction, suggestion, and administration. The large farmer, holding several farms, each looked after by an able foreman, or bailiff, is certainly in the same position, and requires to exercise qualities of deliberation, administration, and organisation.

(*To be continued.*)

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

MILK AS A VEHICLE OF DISEASE.

In your journal of the 23rd ult. is a reference to milk as a vehicle of disease. Permit me to remark that the fact that scarlatina has been conveyed by milk is admitted by all unprejudiced students of the subject, and that, under certain conditions, tuberculosis may be communicated by the milk of tuberculous animals is no less certain; but this is quite a different thing from their being *primarily* bovine diseases. No one who is competent to form an opinion at all has ever even suggested such a notion.

Pure cultures of the tubercle bacillus have conclusively proved the bacterial nature, infectiveness, and consequently communicability, of the disease, by inoculation, by inhalation, and by the consumption of milk containing the bacilli, which it does when, and only when, the mammary glands are implicated, or when, as in so-called acute miliary tuberculosis, the entire fluids of the body, the blood, and lymph contain the bacilli.

The identity, too, of the tubercular process and of the pathogenic organisms in man and beast, notwithstanding some differences in the appearances exhibited in, for example, human tubercular pleurisy and bovine pearl disease, is also established. But that man and cow may be attacked by the same specific disease, does not prove that man gets it from the cow, or the cow from man. As regards tuberculosis, there is a virtual consensus of opinion among pathologists, but not, as the writer of your article imagines, on the question of scarlatina. This is indisputably, primarily and essentially, a human disease; milk may serve as a vehicle just as clothes may; or, and here lies the problem for solution, scarlatina may be communicated from man to the cow, and then again to man; or lastly, though it is highly improbable, it may be a disease common to both. To put the matter in the fewest possible words, the hypothesis advanced by Dr. Klein, and which I provisionally accept, is that, under conditions at present not ascertained, the cow is capable of contracting from man the human disease scarlatina; that in the cow it mostly manifests itself in such cases in a greatly modified form, with little fever or disturbance of health, the local lesions being most conspicuous on the udders, and by some confused with, though essentially different from, those of so-called cow-pox and other vesicular diseases.

That this, the Hendon disease, can be communicated to man by direct inoculation, with identical symptoms; but milk being, as experiment shows, the very best culture fluid for the bacillus, it tends, when the milk of affected cows is kept for a few hours, to resume its pristine character and virulence, and the ingestion of such milk induces in the calf a form of the disease, pathologically less removed from the human scarlatina, and in man the fever, with all its usual character, and capable of reproducing itself from the new foci, so that an epidemic may be set up in a place without the introduction of a human individual already infected.

Such is the position assumed by the most advanced among us as a *working hypothesis*. Of bovine *origin* of either tuberculosis or scarlatina, no one in his senses dreams.

EDWARD F. WILLOUGHBY.

THE LEMMINGS OF NORWAY.

Can any of your correspondents give us some plain truth concerning the ways of these little animals? What we read about them savours strongly of mythology. Has Mr. Matthieu Williams observed them in their native haunts?

YETHOLM.

ANSWERS TO CORRESPONDENTS.

C. N. WELMAN.—Your communication is of too speculative a nature for our columns.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

HEARING TRUMPET.—Mr. A. Young, Edinburgh, has patented a hearing trumpet. The bell of the trumpet is formed with the lower side slightly concave, the upper side being semi-circular or arch-shaped. The bell passes backwards and is formed U-shaped; the tubular part passes downwards and ends in a contracted part in which a tube slides telescopically. A curved nipple, entering the ear, slides and swivels on the end of the tube. The bell is attached by its under surface to an elastic strip which terminates over the temples, thus holding the trumpet in position; a rear fastening consisting of a spring wire loop is hidden in the hair or otherwise secured.

FOUNTAIN PENHOLDER.—Messrs. S. Harrison and J. Mara, both of Manchester, have patented a fountain pen. This is an ordinary hollow penholder, having holes in its sides, the said holes being covered by a flexible material. Upon pressure being applied to this material the pen is supplied from the interior of the holder with the writing-fluid through a small orifice at the bottom of the holder. The holder is made in two pieces, one fitting into the other, for easy refilling.

VENTILATING APPARATUS.—An air propellor has been patented by Messrs. J. Crighton, R. Crighton, and G. C. Peel, of Manchester. This invention relates to the construction of revolving air propellors used for ventilating purposes. The vanes of the propellor are constructed in a hollow curved scoop-like form, and are driven with the concave sides of the vanes forwards, by which means, instead of acting centrifugally, as in an exhaust fan, the vanes scoop the air towards the centre, and drive it forwards rapidly along the central portion of the tube, and thus the friction of the current of air against the inner circumference of the conducting tube is reduced to a minimum.

TORPEDO APPARATUS.—An apparatus for feeding and supporting torpedoes to the discharging apparatus has been patented by Messrs. W. C. Storey and G. Poore, Queen Victoria-street, London. According to this invention, torpedoes are carried in suitable supports at the rear of the discharging tube, and are arranged in a circle with their axes in planes parallel to that of the discharging tube. The torpedoes are supplied to the discharge tube by causing the supports that carry them to move so as to bring the torpedoes successively in line with such tube, into which they are then forced by manual or suitable mechanical means.

HYDROGEN GAS.—An apparatus for producing hydrogen gas by a dry method has been patented by Messrs. W. Majert and G. Richter, Germany. This invention is based upon the property which zinc dust possesses, when heated in the presence of certain bodies containing water, of decomposing the latter, so as to form oxide of zinc and hydrogen gas. Cartridges are constructed containing

zinc dust and substances holding the component parts of water in a chemical combination, so that, when the cartridges are subjected to heat in a suitable apparatus, the oxygen of the water will combine with the zinc and form oxide of zinc, and the hydrogen will be liberated and received and retained in a suitable receptacle.

DAMP DETECTOR.—Mr. F. W. Beck, London-road, East Grinstead, has patented an hygrometer. The apparatus consists of an arrangement by which the fibre which grows upon the seeds of a plant called *Erodium gruinum* (a kind of "Cranebill") is made to show with much nicety the presence of dampness in any place. The lower end of this fibre is fixed in the centre of a case containing a dial-plate, on which is drawn a flat spiral of three turns and divided into sections marked 0 to 29. The free point of the fibre follows this spiral line, expanding or contracting according to the extent of the adjacent dampness. This coiling and uncoiling takes place when the detector is placed in atmospheres of different humidity, and wherever the point of the fibre rests the figures indicated show as many degrees of dampness between the beginning of the inner line marked 0, signifying complete dryness, and the end of the outer line marked 29, signifying absolute moisture in the air.

SUBMARINE VESSEL.—Messrs W. C. Storey and G. Poore, London, have patented a submarine vessel. In some submarine vessels there is a chamber furnished with ingress and egress doors for a diver to pass through from the interior to the exterior of the vessel. For this purpose the diver enters the chamber when it is empty, and after closing the ingress door, the chamber is filled with water. The diver then opens the egress door, and passes to the exterior of the vessel. The admission of water alters the buoyancy of the vessel, and consequently its depth of immersion, thereby rendering the operations of a diver difficult to perform. The object of this invention is to overcome these disadvantages. To this end a pump is employed so constructed and operated that it discharges water overboard from the ballast tanks of the submarine vessel at the same rate as it is admitted to the diver's chamber. By this means the weight and buoyancy of the vessel remain unaltered, and its depth of immersion is kept constant.

SAFETY PIN.—Mr. G. W. Herbert, of Birmingham, and Mr. S. Guinery, of Epsom, have patented a safety pin. It is constructed as follows:—At the outer end of the ordinary protecting arm of the safety pin is provided a sheet-metal shield, having at each side an opening through which the end of the pointed arm can pass. The lower part of the shield forms a loop, in which the pointed end lies when the pin is closed. The end of the wire arm, after passing round the end of the shield inside turns upwards between the two side openings, thus forming a central partition, between which and the shield there is room for the end of the pointed arm. In closing the safety-pin, the end of the pointed arm is passed into the shield through one of the side openings, and is prevented from being pushed straight out through the other side opening by the central partition; but when the pointed end has sprung downwards into the lower part of the loop, it can be passed out and disengaged through either side of the pin.

TECHNICAL EDUCATION.

TECHNICAL SCHOLARSHIPS.—At the last meeting of the London School Board a letter was read from the Cloth Workers' Company, in which it was stated that the Company proposed to establish five technical scholarships, to be competed for by boys from any public elementary school in the metropolitan area under 14 years of age who should have reached the seventh standard. Of these scholarships £20 was tenable for the first year at the Finsbury Technical College, and a similar amount was tenable for the second year at the same institution; £30 was tenable in the third year at either the Finsbury College or the Central Institute of the City and Guilds Institute; and in the fourth and fifth years similar sums were tenable at the latter institution. The letter added that one scholarship would come in course of award annually until the whole number were in tenure, and requested that arrangements might be made as soon as possible for the award of the first scholarship, which would include a free course of instruction at the Finsbury Technical College and the Central Institution of the City and Guilds Institute.

PROPOSED TECHNICAL INSTITUTE IN CHELSEA AND PIMLICO.—The Chelsea Library Commissioners have invited the Vestries of St. George's and Fulham to assist in erecting a technical institute on a freehold site generously offered by Earl Cadogan. At the last meeting of the St. George's Vestry a Committee was appointed to confer with the Charity Commissioners on this matter.

ANNOUNCEMENTS.

PEOPLE'S LECTURES.—The last lecture of the final course for the present session was given at Walthamstow last week by Mr. V. B. Lewes, when the chair was taken by Mr. E. North Buxton. The subject of the course, "The Atmosphere in Relation to Health," which was admirably illustrated by experiments on a large scale, proved exceedingly attractive, and the Town-hall was densely crowded each night. The same course was given in the Stratford Town-hall last month to audiences of 1,200 to 1,500 people. Large numbers were turned away from the doors at the second and third lectures. The success of these courses has been so marked that steps have been taken towards securing at both places a full course of ten lectures and classes next winter in connexion with the Society for the Extension of University Teaching, and already a sufficient number of names have been received of persons willing to take tickets to render the success of the centres certain. The remarkably large audiences which have attended the various courses of People's Lectures prove that a real educational need has been touched, and it is to be hoped that the Gilchrist Trustees, who have given such generous support to this movement, will find it possible to carry on the work on a still larger scale next winter.

MELBOURNE CENTENNIAL EXHIBITION.—The Fine Art Committee of the Royal Commission for the Melbourne Exhibition will be prepared to inspect drawings proposed for the exhibition on Wednesday, May 2. Such drawings must be sent to the Pantechnicon, Motcomb-street, S.W., between the hours of 10 and 6 on May 1, accompanied in each case by a note giving titles, prices, and artist's full name and address; and the same particulars must appear at the back of each work. All drawings must be framed and glazed. The expense of packing and conveying accepted works to Melbourne and back, if unsold, will be defrayed by the Royal Commission. Every care will be taken of the drawings, but the Royal Commission cannot, under any circumstances, undertake to be responsible for loss or damage. Drawings by members of the Royal Academy, the Royal Society of Painters in Water Colours, the Royal Institute of Painters in Water Colours, and the Society of British Artists, will be accepted without inspection.

THE COMMISSION INTERNATIONALE DU METRE.—Mr. George Matthey, F.R.S., of the firm of Johnson, Matthey, and Co., has received from M. Flourens, the French Minister of

Foreign Affairs, the Cross of the Legion of Honour, by order of the French Government, for great service rendered to the Commission Internationale du Metre.

THE BRUSSELS EXHIBITION.—We learn that the opening of this exhibition has been postponed from May 5 to May 19.

DIARY FOR NEXT WEEK.

Monday, April 30.—Society of Arts, Cantor Lecture, at 8 p.m. —*Decoration;* by Mr. G. Aitchison.

Tuesday, May 1.—Society of Biblical Archæology, at 8 p.m.—*Old Jewish Legends on Biblical Topics;* by Rev. A. Löwy. *Legendary Descriptions of Hell.*
Royal Institution. Annual meeting, at 1.30.
Institution of Civil Engineers, at 8 p.m.—*The Distribution of Hydraulic Power in London;* by Mr. E. B. Ellington.
Parkes Museum, at 8 p.m.—*Food (Including Milk), Sale of Food and Drugs Act;* by Mr. Charles E. Cassal, F.I.C.

Wednesday, May 2.—Entomological Society, at 7 p.m.
Society of Arts, at 8 p.m.—*Drawing, a Means of Education;* by Mr. T. R. Ablett.

Thursday, May 3.—Royal Society, at 4.30 p.m.
Chemical Society, at 8 p.m.
Royal Institution, at 3 p.m.—*The Chemical Arts;* by Professor Dewar.
Institution of Mechanical Engineers, at 7.30 p.m.—*Third Report of the Research Committee on Friction: Experiments on the Friction of a Collar Bearing. Description of the Emery Testing Machine;* by Mr. Henry R. Towne.
Camera Club.—*Demonstration of the New Platinotype Process;* by Mr. Willis.

Friday, May 4.—Royal United Service Institute, at 3 p.m.—*Horse Artillery;* by Captain M. Robertson.
Royal Institution, at 9 p.m.—*The Invincible Armada;* by Professor J. K. Laughton.
Institution of Mechanical Engineers, at 2.30 p.m.—*Supplementary Paper on The Use of Petroleum Refuse as Fuel in Locomotive Engines;* by Mr. Thomas Urquhart.
Parkes Museum, at 8 p.m. —*Infectious Diseases and Methods of Disinfection;* by Mr. Shirley F. Murphy.
Society of Arts (Indian Section) at 8 p.m. —*The Injurious Effects of Canal Irrigation on the Health of the Population of the Punjab;* by Surgeon-General H. W. Bellew, C.S.I.

Saturday, May 5.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner;* by Mr. C. Ambruster.

SALES.

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Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

SECONDARY EDUCATION.—In supporting Mr. Acland's motion in the House of Commons, to the effect that the attention of the Government should be no longer limited to primary education, Mr. John Morley made a very telling speech. He based his remarks on three kinds of authority, the man of science, the man of business, and the man of letters. For the man of science he took Professor Huxley, who had said: "The organisation of industrial and commercial education is not the least of the great problems which await the future. That this problem has to be solved under penalty of national ruin proves to be no longer a mere alarmist fancy." That was the opinion of the man of science. As the man of business he quoted Mr. Swire-Smith, whose recent paper on technical education we recently reported: "In a large proportion of the northern manufacturing towns there are no really secondary schools at all. Such middle-class schools as exist are graded, not according to educational standards, but according to the social grades of the scholars; the result being that instead of all the children, as in every other country, receiving their elementary education in the public schools, the larger ratepayers, for fear of contact with those below, send their children to private schools, where they obtain inferior elementary instruction at a higher price, supplemented by extras which in too many instances do not represent any solid teaching." For the man of letters Mr. Morley quoted the following pithy remarks of the late Mr. Matthew Arnold: "Our middle classes are among the worst educated in the world. The education of the mass of the middle classes is vulgar and unsound. Our body of secondary schools is the most imperfect and unserviceable in civilised Europe. Our middle-class is the worst-schooled in civilised Europe."

Mr. Morley very truly remarked that, after this consensus from so many different sources, we need no longer time to convince ourselves of the existence of the want which we have to remedy. The practical question is, what is to be done? It is no doubt eminently desirable that means should be adopted for ascertaining what kind of work a school is doing. It is true that many schools are examined annually by the Oxford and Cambridge Schools Examination Board, and that others adopt the local examinations; but it is notoriously the fact that only picked scholars are sent up for these. To remedy this and other defects, it is proposed to have a Minister of Education, whose duty it would be to keep up a constant pressure in the direction of instructed public opinion, so as to focus the information on educational subjects. It should also be his business to judge the direction in which the educational indications of the time are tending, and by degrees to force on those bodies which do not take voluntary action, a modification of their system in the desired direction. Many other questions naturally suggest themselves for consideration, and not the least among them is some system for weeding out incompetent teachers. Unfortunately, they are very numerous, for at present any one who has made a failure of life thinks himself fully competent to teach.

ELECTRIC LIGHTING FIRE RISKS.—The Society of Telegraph Engineers and Electricians has just issued a very useful set of rules and regulations for the prevention of fire risks arising from the use of electricity for lighting purposes. They are not intended to supersede the detailed rules which fire offices may issue for their own protection, but rather for the guidance of those who possess or propose to have electric lighting apparatus. As regards "conductors," they must have a sectional rea and conductivity so proportioned to the work they

have to do that, if double the current proposed is sent through them, their temperature must not exceed 15c° F. They should be visible and acccessible, and when within buildings they should be insulated, as also the parts of fittings which have to be handled. The insulating material should be damp proof, and should not soften at a temperature under 170° F. Even the depredations of rats and mice have to be provided against by encasing the conductors in some suitable hard material. Gas and water pipes must not be used as part of the circuit, as their joints are rarely electrically good and therefore become a source of danger. In the case of overhead wires, every main should have a lightning conductor at each point where it enters a building. It is also recommended, as we ourselves have urged, that the positive lead should be coloured differently to the negative.

Electrical fittings generally, switches, commutators, resistances, bare connections, lamps, etc., should be mounted on incombustible bases. Vulcanite bases are undesirable in damp situations, and the cracking of porcelain and earthenware fittings is a source of danger, unless precautions are taken in the fixing. All circuits should be protected with cut-outs, and all leads from the mains, or small conductors from larger ones must be fitted with cut-outs at their branching points. Arc lamps must be guarded by lanterns or netted globes, so as to prevent danger from sparks and from falling glass or pieces of incandescent carbon. Dynamos should always be fixed in dry places, and both primary and secondary batteries should be placed and used with the same precautions as prescribed for dynamos. Special care is also necessary when "Transformers" are used. In conclusion, it is pointed out that the value of frequently testing and inspecting the apparatus and circuits cannot be too strongly urged as a precaution against fire. Cleanliness of all parts of the apparatus and fittings is also essential to good maintenance and efficient working. The risks of fire from electricity are not nearly so great as with gas or oil, provided the above points are attended to, and the moral of the Society's useful lesson is that competent electricians should always be employed to supervise the fitting up of the electrical appliances.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

At a recent meeting of the Physiological Society of Berlin, Herr Meyer "discussed the nature of ventriloquism, and combated the opinion so widely spread among physiologists, that it consists in speaking while inspiring, and without the cavity of the mouth acting in any way as a resonator." He described a number of experiments and observations fully refuting the old idea upon which the name is founded, viz., that the ventriloquist speaks from the stomach or abdomen. He is himself a skilful ventriloquist, and his own sensations, and the observations of Professor Gad upon him, prove that the abdominal muscles do nothing in ventriloquism, while, on the other hand, Herr Meyer himself, by means of an apparatus recording graphically the variations of air pressure, proved "that the curve obtained when a sentence is spoken in the ordinary way is in all respects identical with one which is described when the same sentence is spoken ventriloquially." The *volume* of air expired in the latter case was, however, considerably less, in the ratio of 9 to 13.

My quotations above are from an abstract in *Nature*, January 12th last, from which it appears that Herr Meyer and Professor Gad are not acquainted with the work of M. de la Chapelle, *Censeur Royal* at Paris, Member of the Academy, and a Fellow of our Royal Society, etc., whose conclusions concerning the abdominal theory and the inspiration and non-resonance theory were identical with those above stated. His rather pedantic work was published in 1772, and his conclusions, both positive and negative, were afterwards confirmed by a Committee of the Academy of Sciences, and ultimately by the whole Academy.

The ventriloquists by whose aid M. de la Chapelle made his researches were Baron Mengen, of Vienna, and a grocer of St. Germain en Laye, both amateurs, and perfectly candid as to their methods of producing the illusions.

Baron Mengen ridiculed the old stomach theory, and stated that he owed his art to a natural propensity to imitate the cries of animals and other sounds. This broke out at a very early age of childhood, and presently extended to the imitation of distant sounds by a sort of suppression or muffling of the voice. His method of obtaining this effect he describes as follows:—

"I press my tongue strongly against my teeth and left cheek, and the voice which appears articulated by the mouth of the figure (he here refers to a doll with which he carried on humorous dialogues) is formed, in reality, between the teeth and left cheek of my own. For this I use the precaution to *hold in reserve* in the windpipe ('le gosier,' he says, but he really means the lungs, such a reserve in the trachea being impossible) a sufficient portion of air either to sing or speak, without the stomach or belly giving any assistance, and it is solely with that portion of air in reserve—moderated, retained, and suffered to escape with effort—that I produce the voice that I wish to make heard. Add to that *a quality in my tongue, extremely subtile* and rarely possessed, by means of which I articulate all syllables and words (either singing or speaking) without in the least moving the lips, and taking great care to retain to the end of each period, phrase, or sentence the air which comes from the lungs for renewing of my respiration, *which requires a very good chest.*"

M. Saint Gille was similarly communicative, and being near to Paris, was the subject of a long series of observations. The theory of M. de la Chapelle, confirmed by the Academy, was that the sound varies in its effect on the ear according to the distance or place from whence it comes. But every sound that reaches the ear is a sound that may be imitated. The whole art of ventriloquism is the power of imitating sounds which we are accustomed to refer to certain distances and certain situations. M. de la Chapelle was at first deceived by the ventriloquists. He tells us how on his first interview with M. Saint Gille he was rather surprised and alarmed at a cry from the roof of a neighbouring house. After a while the illusion ceased, and he referred sounds to the mouth of the speaker which, others hearing them at the same time, referred to distant places.

Having satisfied themselves on this point of mere imitation, the academicians proceeded to investigate how it was effected, and concluded that by habit a power over the larynx was acquired by which it could be readily shut or opened in the required degree, with the additional power, from *flexibility* of the tongue, to articulate *within* the mouth, or even at the *back part of it.*

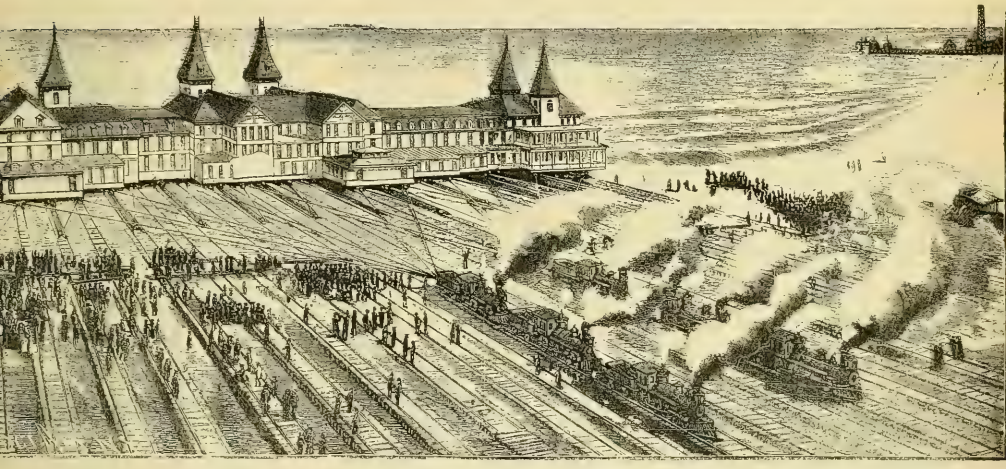
They believed the constriction and expansion of the larynx to be very fatiguing, and attended with hoarseness after lengthened exertion. They observed that M. Saint Gille appeared fatigued before the end of his exhibition, and lost some degree of his power to create the illusion; but each exertion was followed by irritation and a slight cough, and that when he was *enrhûmé*, suffering from a cold, he had great difficulty in speaking *en ventriloque.*

M. de la Chappelle and the other academicians unite in their refutation of Conrad Amman's theory, which asserts that ventriloquism depends upon articulation during inspiration.

A very skilful ventriloquist and mimic, M. Alexandre, visited this country in 1823-24, and was the subject of careful investigation in Edinburgh, to which he submitted willingly and candidly. His testimony was almost identical with that of Baron Mengen and M. Saint Gille, excepting that he confessed his inability to produce the labial consonants without moving the lips. The academicians found that this was the case with M. Saint Gille. M. Alexandre ridiculed the old stomach theory, stating that he had neither tongue nor teeth there, and also asserted positively that he did not speak during inspiration, adding that when he spoke *en ventriloque*, he was not aware that he breathed at all.

He further stated that the idea of "throwing the voice" in a certain direction is absurd. The ventriloquist first directs the attention of his hearers to the direction from which the sound is to come, and then imitates a sound due to the distance of the spot; as when, for example, at Prince Metternich's Hotel in Vienna, he hung a rope out of a window to which a weight was attached, then hauled up the rope and gradually conversing with a man supposed to be suspended by it; the voice of the man approaching nearer and nearer, yard by yard, until suddenly when near the window he dropped the rope, imitated a crash and the groans of a dying man below. The rope and the hauling fixed the attention towards the required direction.

The antiquity of ventriloquism and of the idea of speaking from the stomach are remarkable. The Egyptians, Assyrians, Jews, and Greeks record cases of familiar spirits, residing in the stomach, and speaking from there. The evil name for such demon *Ob* (plural *Oboth*) is translated in the Septuagint by the word *engastrimathos*, and in the Vulgate *ventriloquus.* The witch of Endor is called *Engastrimethon.* St. Chrysostom and Æcumeneus both speak of Diviners called *Engastrimandu* and ancient treatises on the subject are still extant.



MOVING THE BRIGHTON BEACH HOTEL.

MOVING THE BRIGHTON BEACH HOTEL.

ON former occasions we have referred to the proposed moving of this hotel, and in our issue of April 13 we announced that the project had been successfully carried out. We are now able to give our readers further particulars of this engineering feat, which we take from a recent number of *Scientific American.* For many months there has been a marked tendency on the part of the water to wear away the sandy beach upon which the building was erected. During the past winter this tendency increased, and the water made its way under the hotel, and it was evident that, unless some preventive measures were taken, the house would be undermined and carried away.

An adjoining building, of much smaller size, called The Pavilion, had already been moved several times, as

the waters advanced. Small as it was, compared with the hotel, it had been moved in three pieces, having been cut into sections for the purpose. After this experience the most natural idea was to attack the problem of dealing with the great hotel upon a similar basis. It was proposed to saw it into a number of sections, and to move it back piecemeal. The cost of the operation deterred the managers from attempting it.

The hotel is owned by the Brooklyn, Flatbush and Coney Island Railroad Company, and the superintendent of the road, Mr. J. L. Morrow, and the secretary, Mr. E. L. Langford, in discussing the matter, originated the highly ingenious and novel plan which was adopted. Its execution was confided to Mr. Morrow. The plan was to place the hotel upon a number of freight cars, resting upon parallel tracks, and to draw it where wanted by locomotives. The nearest approach to such a method is to be found in the Eads Ship Railroad, and the moving of the gigantic hotel is a happy augury for the success of the other project.

The building is a wooden structure four hundred and sixty-five feet long, one hundred and fifty feet deep, and three stories high, as regards its main portions. Five towers rise from the roof. Its longer front faces the sea. It had to be moved backward in the direction of its shorter axis. The estimated weight of structure was five thousand tons. From one hundred to one hundred and fifty tons of plaster were contained within it. It rested upon a series of short posts which, in their turn, were supported by piling.

The first operation was to lay a series of parallel tracks from underneath the building. Longitudinal planks two inches in thickness were placed in the lines where the rails were to run. Upon these, the cross tiers or sleepers were placed, and the sand was eventually rammed under the planks and sleepers alike. This gave the sleepers a double support, directly from the earth, and also from the stringer planks. The rails were of the ordinary type, weighing fifty-six and sixty pounds to the yard. They were laid with a four foot nine inch gauge rod, and rather freely, so that their gauge was probably five-eighths of an inch more than the normal. The idea of this was to provide for any lateral play that might be necessary. Twenty-four lines of tracks were laid, and were carried under the building and out from it about three hundred feet landward. To lay tracks for moving the building its own depth, a mile and a half of rails were required. One hundred and twelve platform cars were hired for carrying the building from the Iron Car Company. Their break wheels were removed, and stowed each pair under their own car. The building was next attached in twenty foot sections, and packed up.

One 90-ton, three 60-ton, five 30-ton, and four 10-ton hydraulic jacks were used. The sills were raised from the supporting posts, and the cars were rolled under, carrying with them transverse timbers of 12 by 14 yellow pine. Each piece rested upon two cars on adjacent tracks, the longest timber being only forty-one feet in length. One hundred and ten thousand feet of this timber were required. As far as possible the timbers were made to bear upon the central axis of the car, and over the trucks. The house was raised enough to permit the cars and timbers to go under it, one or two inches clearance being allowed for. In one place the building had settled nearly a foot. This was straightened up. The cars on each track were coupled together, and then were jacked apart so as to pull out the drawheads to their fullest extent. The weight of the building lowered upon the cars kept them in this position. In some cases this jacking apart was omitted. Such cars were connected by rope slings twisted so as to rigidly hold them together. The idea was to prevent any separation or alteration of the longitudinal distance between cars. No system of diagonal bracing was used, the utmost simplicity characterising the arrangement.

In sections of twenty feet the whole building was gradually placed upon the cars. It is believed that the strain upon some of them cannot have been less than seventy-five tons, yet nothing gave way, although the springs were strongly compressed, so that the bolsters were nearly in contact.

A number of heavy blocks and falls were then connected to the front ends of the twenty-four lines of cars. As abutment, the forward blocks were attached by chain slings directly to the rails. The tackles were arranged so that there were twelve falls, the end of each of which was carried to the motors. A number of thirty-five ton locomotives were placed upon two tracks, and six ropes leading from the falls were attached to the coupling at the rear of each set of engines. Some of the tackles crossed each other, so that each set of engines had its pulling strain distributed over more than half the face of the building. The strain was taken up on each fall before it was attached. Three tons of rope were used in making these connections, and, when all was ready, the signal to start was given. For the first pull, April 3rd, the orders were to start the building, and then immediately stop. Six locomotives were used. The ropes gradually tightened, and the building without a shake or tremor moved back slowly, and stopped after a short distance had been traversed. A careful examination showed that all had worked perfectly. On the afternoon of the same day a longer pull was given. Then on April 4th, with only four engines, the hotel was again moved, and was left 239 feet behind its original position. The work had now to stop as far as moving the building was concerned, because the rails were not laid any further, and because the piling of the new foundation was not all driven. The rails, sleepers, and stringers left between the house and the water were transferred to the front, and a way provided for the hotel to move the rest of its journey to its new resting-place, 495 feet from its original location.

No difficulty of any kind was encountered. Want of power had been the principal thing that was feared, but four locomotives proved enough to carry the house along at the rate of a fast walk. The engines were found to work admirably in producing an absolute and definite pull. The total weight moved was placed at one thousand tons for the cars, and five thousand for the building. This represents the weight of about one a half miles of loaded cars, or of a large ocean steamer.

Reference has already been made to the Eads Ship Railroad. In the moving of the great hotel, a far more difficult task than that called for in the operation of the ship railway was accomplished. Instead of a ship, compact and strongly built to resist every kind of strain, a large house, of relatively little intrinsic strength, was dealt with. A little settling or inequality of movement would have wrecked it. As regards power, light locomotives were used. Compared with an iron or even wooden ship, the hotel might be pronounced a house of cards. The confidence in the Eads scheme cannot but be largely increased by this feat in engineering

FORAMINIFERA.—II.

(Continued from page 390.)

THE group of the Arenaceous Foraminifera is well represented here by *Reophax scorpiurus*, Montf. (fig. 9), the animal of which constructs a test of very irregular fragments. The series of chambers commence in slender form, rapidly increasing in width and forming together a curved or crooked line. It is an abundant form both in arctic and tropical seas, and has been recorded in the fossil condition from Switzerland in rocks of Jurassic age. The test varies in regard to its composition according to the surrounding material from which it builds, using spicules, shell or coral fragments, or other substances.

Textularia agglutinans, d'Orb. (fig. 10), a good example of the Textularian forms, consists of a double series of alternating chambers, with the aperture slit-like. This type is decidedly Arenaceous, others, especially the smaller varieties, are Hyaline, or only partially Arenaceous. The figure is taken from a specimen out of the London clay of Piccadilly; it is also common in recent soundings.

Lagena, a one-chambered flask-shaped shell, is one of the starting-points of many Hyaline Foraminifera which are beautiful adaptations and arrangements of this simple form on certain plans, resulting in a great diversity of forms. *L. squamosa*, Mont, sp. (fig. 11.), is a form the surface of which is covered with a scaly decoration. The specimen figured is from the Pliocene beds of St. Erth, but it is also found widely distributed, both as to depths and localities, at the present time. *Nodosaria*, a genus characterised by a simple rectilineal series of Lageniform chambers, is represented here by *N. raphanus*, Linné sp. (fig 12), from the Gault of Folkestone: it has occurred as far back as the Trias. It is a very variable form both in size and conformation. The sub-genus *Dentalina*, which differs only from the preceding by the shell being curved instead of straight, is illustrated by *D. adolphina*, d'Orb

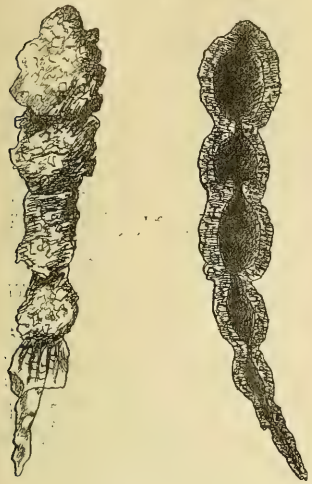


FIG. 9.—*Reophax scorpiurus*. Montfort. × 30.

FIG. 11.—*Lagena squamosa*. Montagu Sp. × 60.

FIG. 14.—*Cristellaria cultrata*. Montf. Sp. × 30.

FIG. 15.—*Uvigerina asperula*. Czyzek. × 80.

FIG. 13. — *Dentalina adolphina*. d'Orb. × 30.

FIG. 12. — *Nodosaria raphanus*. Linné Sp. × 30.

FIG. 17.—*Rotalia beccarii*. Linné Sp. × 30.

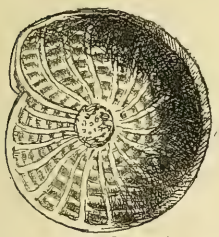


FIG. 18.—*Polystomella crispa*. Linné Sp. × 30.

FIG. 10.—*Textularia agglutinans*. d'Orb. × 30.

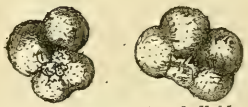


FIG. 16.—*Globigerina bulloides*. d'Orb. × 30.

sp. (fig. 13), in which the surface of the shell is decorated by delicate spines and the primary chamber armed by a long stouter one. The specimen is from the London clay of Piccadilly. It has also been found in the Pliocene of Kar Nicobar and in Miocene beds. *Cristellaria cultrata*, Montf. sp. (fig. 14), is a form consisting of a series of modified Lageniform chambers, wrapped spirally and partly embracing those first formed. This variety, from the Gault of Surrey, has a beautifully translucent keel bordering the shell. This form is also found in recent soundings. In *Uvigerina* the shell consists of a triple series of chambers coiled spirally to produce an elongated form. The specimen of *U. asperula*, Cz. (fig. 15), from the London clay of Piccadilly, has its surface covered with minute prickles, and the primary chamber commences with a spine. It is found rather plentifully, both fossil and recent.

The form next taken is *Globigerina bulloides*, d'Orb. (fig. 16), a shell composed of a series of Orbuline or more or less spherical chambers arranged in a helicoid spiral. The inferior side with the aperture is shown in the right-hand figure. This type constitutes the greater part of the chalky ooze dredged from the Atlantic. The same form, but smaller in size, is found numerously in the white chalk. *Rotalia beccarii*, Linné sp. (fig 17), is found commonly in many recent shore deposits of Britain and elsewhere. It is found also fossil in beds of Miocene and Pliocene ages; in the Chillesford Crag it occurs very diminutive in size. *Polystomella crispa*, Linné sp. (fig. 18), is a shell which may be found like the preceding in British shore gatherings but much more abundantly. This shell exhibits on the exterior the last whorl of chambers only.

Having thus taken a few examples from the almost endless variety of aspects which these shells present we may wish to study the Foraminifera by actual comparison. There will be no difficulty in procuring material upon which we may work, as deposits occur in nearly every stratum of any extent in sedimentary rocks, including shelly clays and limestone beds. Very frequently the oolitic limestones when examined in thin sections, show each individual grain with its nucleus formed by a Foraminifer. The shells may also be obtained from dredgings or soundings taken at almost any depth; and at some stations the calcareous sand consists of a nearly pure assemblage of them. Along our own coasts foraminiferal sand may be procured either by dredging or by collecting the material which has been stranded on shore by the ebb tide.

Walking along a sandy shore during the receding tide one will generally discover a series of parallel streaks left on the sand, striking the notice of the observer by their arrangement in alternate black and white lines. If this white portion be scraped up and examined it will be seen to consist of little else than very clean specimens of Foraminifera, with perhaps some spines of echinoderms, valves of ostracoda, fragments of polyzoa, and minute shells of mollusks. The black portion may be ignored, as that will be found to consist of particles of carbonized seeds, fragments of seaweed, and chips of coke from the furnace of some passing steamer. In collecting recent Foraminifera in this way it is very noticeable that these shells occur in greatest numbers on limestone or chalk-bound coasts, as, for example, along the shores of Sussex and Kent where entirely pure gatherings may often be taken. On the other hand, in the vicinity of land destitute of limestone rocks, the material left by the side may consist almost entirely of seeds or seaweed fragments; clearly indicating how the dissolution of the carbonate of lime by carbonated waters and its separation by these tiny animals from the water work together.

(To be continued.)

THE WINTERING OF WATER WEEDS.

THE writer has had under observation during the past winter a number of water weeds, including Utricularia, Myriophyllum, and Hydrocharis. In October they had spread out into a great tangled mass, floating in or upon the water. As the cold weather came on, the buds at the ends of the branches ceased to expand, then the older stems and flowers began to wither. At Christmas the appearance of the plants may be described thus:—Hydrocharis had sunk to the bottom and disappeared; Utricularia and Myriophyllum had turned to a greenish-grey colour, and had become extremely fragile. The terminal buds were of a bright green colour, very closely wrapped, and dragged down to the bottom by the sinking of the old stems. As spring came on, the withered plants broke up completely, and formed a soft grey film overlying the bottom. The slightest disturbance was now enough to break up the decayed mass and liberate the buds, which then floated upwards. Here and there detached buds of Hydrocharis began to reappear on the surface in the same way.

Flotation in all these plants is provided for by air cavities, which occupy the hollow joints of the stem. It is easy to demonstrate the existence of such cavities by teasing out a bit of stem in water under the microscope. Tiny air-bubbles are disengaged in large numbers. A carefully prepared cross-section shows a large and simple cavity. If an old and decaying stem is teased out in the same way, no air escapes; it has become waterlogged. Since the plant is not, as a rule, in direct contact with the air, we must suppose that the air is secreted by the tissues. Probably it is not ordinary air at all, but oxygen. No doubt it is continuously formed while the tissues are green and active. When the season of growth is passed, and little assimilation of carbon dioxide takes place, the supply of oxygen is cut off, and the plant sinks to the bottom. It will be seen that the process of natural decay is thus turned to good account by water weeds, which employ it to shelter themselves from the action of frost, and also to multiply the centres of growth by setting free a great number of terminal buds.

INFLUENCE OF THE MOON UPON VEGETATION.—M. G. Delaunay, an inspector of forests, delivered recently a lecture on this much-disputed subject. *Ciel et Terre* gives an abstract of his discourse from the *Revue des Eaux et des Forets*. Referring to the notion that it is unwise to plant during the time of new moon, he said, that as far as forest-trees and fruit-trees were concerned this opinion was supported neither by theory nor by practice. As to herbaceous plants, and in particular pot-herbs and salads, it is alleged that the young plants are eaten off by slugs. He suggests that at near full moon the small grey slug, which loves darkness, may not come out so much to feed. He thinks that the soundness of timber is affected not by the phase of the moon at the time of felling, but by the season of the year.

General Notes.

Geology for All.—A conspectus of the science in a popular form, by Professor J. Logan Lobley, will be published shortly, by Messrs. Roper and Drowley, Ludgate Hill.

Regulator for the Electric Light.—M. Lippman handed in to the French Academy of Sciences a paper by M. Pollak on an electric light regulator founded on the thermic expansion of the conducting wires. These wires in expanding keep up the mutual distance of the carbons.

Hereditary Stature.—Excess in height is rarely perpetuated even if both parents are above the average; the height of the offspring being only about a third of the excess reached by the parents. The offspring of parents of unequal height most frequently follow the shorter.

Fixation of Nitrogen by Vegetable Soil.—The discussion on this question between M. Schloesing and M. Berthelot (*Comptes Rendus*) continues. The former stated that in 1859 Boussingault had expressly said "The soil is the habitation of beings which preside over chemical transformations."

Sanitary Value of Tea.—Professor Germain Sée (*Hygiène Pratique*) pronounces tea to be the best digestive and the surest means of maintaining the intellectual energy. He recommends that it should be used weak, at a high temperature, and in the quantity of at least half a litre!

Recognition of Science by the State.—Mr. Jennings lately said, in the House of Commons, that of the £1,200 yearly placed at the disposal of ministers for rewarding eminent discoveries in science or distinguished proficiency in literature and art, very little goes to persons who have made their mark in these departments.

Great Geodetic Junction.—The great Anglo-Franco-Spanish meridian has now been connected with measurements in Africa, extending as far as Laghouet. The study of this arc, extending from the Orkneys to the confines of the Sahara, will doubtless furnish important results as to the true form of the earth.

Longevity in Japan.—According to the *Medical Press*, among the 38 million inhabitants in Japan, there are upwards of a million persons between the ages of 70 and 80; a quarter of a million between 80 and 90; and 12,200 between 90 and 100. There are 97 centenarians, two of whom have respectively reached the ages of 109 and 111.

Influence of Comets upon Temperature.—*La Liberté* suggests that the comet which we have recently lost sight of may have brought us, not as it has been sometimes supposed, an increase of heat, but a fall of temperature. We hear of the wines of "comet years," but the visit of the last "heavenly stranger" may be remembered for icicles.

Curious Phenomenon.—*Ciel et Terre* informs us that on April 3rd, about 2 p.m., it suddenly began to snow at Brussels after a very sunny morning. The flags of the foot-ways had been strongly heated and there was produced a very rapid evaporation. A white smoke, which rose to the height of nearly twelve inches from the ground, extended along the footways.

Market Value of Scientific and Technical Training.—A fully qualified chemist, holding the diplomas of M.A., F.C.S., and F.I.C., writes to the *Chemical News* to say that he was offered £20 for analysing 36 samples of milk weekly, during the whole season, from April to November. He calculates that this would be about 3¾d. per sample, and asks, "How is it done?"

An Interesting Experiment.—The Pittsburg Electric Railway Company, finding its line blocked with snow, ordered a large quantity of salt to be thown along the line so as to dissolve it. The conductors working at a difference of potential of 500 volts were carried in wooden troughs, and the melting snow and salt speedily established a circuit between the conductors with the result of setting fire to the troughs.—*Electrical Review*.

Gulach's Embryoscope.—This instrument, described in the *Anatomischer Anzeiger*, supplies, says the *American Naturalist*, a great and long-felt desideratum in experimental embryology. It is a mechanism for closing hermetically a circular opening made with a trepan in the shell of an egg, and it serves the purpose of a window, through which the embryo may be observed, and its development followed from day to day.

Albumen for Industrial Purposes.—According to *Le Voltaire*, a chemist of the name of Waters has at last succeeded in extracting albumen from the eggs of fishes. By means of a preliminary washing he removes blood and other impurities from the ovaries of the fish. They are then burst, and the eggs are laid to steep for twenty-four hours in three times their weight of water containing about 5 per cent. of soda or potash. On heating the liquid at the end of this time to about 120° (?) the albumen separates and may be collected in a satisfactory state of purity.

The Depreciation of Cattle in France.—The fall in the value of cattle experienced in all parts of France is a disastrous fact for farmers and graziers. In Normandy cows which in April 1887 were bought at a mean price of 500 francs, are not now worth 150 francs. In Le Cantal a pair of oxen for which 1,300 francs had been offered in September last, have recently, according to the *Journal de l'Agriculture*, changed hands for 300 francs. Such facts show that a peasant proprietary and a system of small holdings do not ward off agricultural depression.

An Aborigines of France.—M. Bouchard maintained, at a meeting of the Anthropological Society of Bordeaux, that the basis of the population of France is Iberian, and, therefore, in his opinion, like the Finns and the Hungarians, of the Mongelian stock. He repudiates the common notion that the French are either a Latin or a Celtic nation. He said: "The Celts and the Romans

were nothing but conquerors who planted themselves in the country just as the Germans have done in Alsace Lorraine. Our Iberian ancestors hated the Roman as the Alsatian hates the Prussian."

SUBMERGED FORESTS.—Recent high tides on the Breton Coast between St. Malo and St. Lunaire have laid bare the remains of a submerged forest. The bay of Mount St. Michel presents a surface of 250 square kilometres invaded by the sea since the Roman conquest of Gaul. In the eleventh century the country surrounding the abbey was covered with a dense forest, distant about six miles from the sea. The trees lately freed from their covering of sand are in the course of being converted into coal. The *Publicateur de St. Briene* commends this submarine forest to the careful notice of geologists.

SUBMARINE BOAT.—Mr. Chapman and the Brothers Brin have, it is stated, recently invented a new type of submarine boat, the propulsion of which is effected by the combustion of a mixture of compressed oxygen and petroleum spray, either in a gas engine, or in the furnace of a steam boiler. The oxygen is compressed to 80 atmospheres, at which pressure a considerable quantity can be stored in a comparatively small space. The immersion of the vessel is effected by a centrifugal pump which draws in water at the bottom of the boat, and forces it out vertically through two reaction tubes. The depth of immersion is automatically controlled by means of electricity.—*Industries.*

THE LAKE AGE IN OHIO.—Professor Claypole (*American Naturalist*) concludes that the ice at one time dammed up the Ohio above the site of Cincinnati, forming a sheet of water which he names Lake Ohio. As the banks of the Ohio are 400 to 500 feet high at Cincinnati, the ice must have been thicker than this. If assumed at 500 feet, the rim of the ice would be 365 feet above the level of Lake Erie. The entire south of Ohio, a large portion of West Virginia, and parts of Kentucky and Pennsylvania must thus have been under water, forming a lake about 400 miles by 200. At one time Lakes Erie and Ontario formed a single vast sheet of water, held by an ice-dam at a level of 700 feet above the sea.

NAMES OF MINERALS.—We borrow from the *American Naturalist* a few notes on the ancient names of minerals, and the accompanying traditions. The name DIAMOND is derived from the Greek *a*, negative, and *δαμαω*, I conquer, meaning unconquerable. The name was originally applied to hard steel and iron, and Hesiod used it in that sense about 750 B.C. Since the days of Theophrastus (about 300 B.C.) it has been applied to the diamond, in Greek *αδαμας*. Pliny asserts that if laid upon an anvil and struck with a hammer it remains unhurt, and causes the latter to recoil; or, indeed, often bursts hammer or anvil. Only by moistening it with the blood of a he-goat can it be reduced to such a condition that it may be crushed.

NICCOLITE is derived from the neolatin *niccolum*, the metal nickel. The Gothic *nickr* or *nickl*, in Anglo-Saxon *nicr* or *nicor* (related to the Icelandic *unickia*, to seize or carry off), was a demon who inhabited pools of water. From the above is derived the German *Nixe*, a female water-spirit who was not always cruel, but sometimes gave valuable aid to unhappy lovers. The masculine *Nix*, of the same family, was a morose, objectionable character. His name serves to this day in Germany to scare children away from the water. From the same source we have obtained *Nick*, commonly used as *Old Nick*. The old high German *nickel* signifies a small vicious horse; also a dwarf. The idea of a dwarf, or stunted animal, was modified into the personification of a malicious spirit. The old German miners frequently found ores which looked very promising, but which on smelting yielded no silver, but gave off foul odours. The explanation adopted at that time was that wicked spirits infested the ores.

THE ABSORPTION BANDS OF OXYGEN.—M. Janssen (*Comptes Rendus*) presented a paper on the absorption bands of oxygen. According to his researches, oxygen displays two systems of spectral rays: firstly fine lines and then dark and blunted lines. He finds that the distinct appearance of the bands and their breadth are in close relation with the thickness of the layer of oxygen traversed and with the square of the density. The lines depend only on the thickness and the simple density. The law has been verified at pressures varying from six to more than 100 atmospheres. An unforeseen confirmation has just been produced. M. Olzewski, of Cracow, has seen the bands produced very distinctly in liquified oxygen observed at the thickness of seven millimetres. Now calculation proves that, according to Janssen's law, the bands should commence to be visible at a thickness of $4\frac{1}{2}$ millimetres. M. Cailletet, who first succeeded in liquifying oxygen, places his apparatus at the disposal of M. Janssen, who is happy to accept this precious co-operation. It will then be seen if the bands appear at the thickness of $4\frac{1}{2}$ millimetres.

NUMERICAL PROPORTIONS OF MEN AND WOMEN.—Dr. W. K. Brooks, in the *Morphological Notes of the John Hopkins University*, remarks that Dussing has discussed the variation in the ratio between male and female animals and plants, and has shown that a favourable environment—in other words, prosperity—tends to produce an excess of females, and unfavourable surroundings an excess of males. Dr. Brooks finds reasons for believing that the existence of this variation is due to an adjustment which has been gradually brought about in order to secure stability as long as the conditions are favourable, and to increase the probability of change when the conditions are unfavourable. If this be true, a race or species which is approaching extermination, should have an excess of males. Dussing has collected many facts to show that such is actually the case, and the author supports his views by a discussion of the statistics of Victoria. The population of Australia consists of a small and decreasing number of aborigines and a prosperous and increasing population of immigrants—chiefly British—and their descendants. As the original population is disappearing, we should expect to find the males among them more numerous, as compared with the females, than among the immigrants. Such is, accordingly, the case. On the average, for all Australia, there are 143·72 aboriginal males to each 100 females. Among the immigrants there are only 118·64 males to each 100 females. The difference would be yet more striking were it not that the immigrants—those especially of Chinese origin—comprise more men than women.

OPTICAL ILLUSIONS.

TEN years ago Professor Silvanus P. Thompson, now the Director of the City and Guilds of Finsbury College, described some designs which gave rise to optical illusions, and which had not previously been

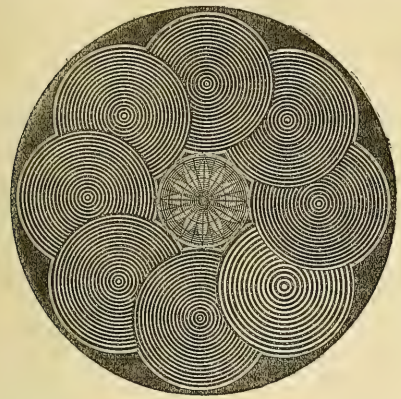


FIG. 1.

observed. These figures he called strobic circles; they consisted of concentric circles which appeared to revolve when the drawing was rotated eccentrically by a horizontal movement similar to that employed in rinsing a basin. The circles in figure 1, especially if drawn on a

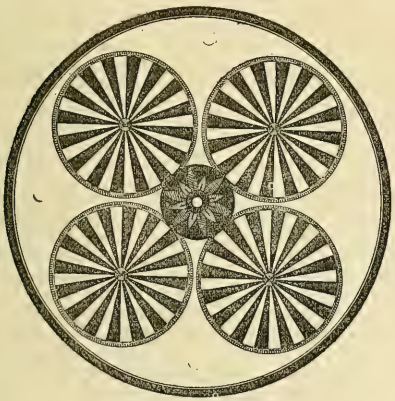


FIG. 3.

much larger scale, show this phenomenon very plainly. The figure need only be placed in the palm of the hand and moved rapidly with a circular motion, when the circles will appear to revolve.

Recently some new and curious illusions of an analogous nature have been communicated to *La Nature*, from whose pages we borrow our account. The rosettes in figure 2 appear to turn when a rotary motion is given to the design, and as the alternate black and white stripes are more distinct than in figure 1 the phenomenon is easily seen, even on the scale of our illustration.

Figures 3 and 4 undergo a very curious change when they are rotated on their centres like ordinary wheels.

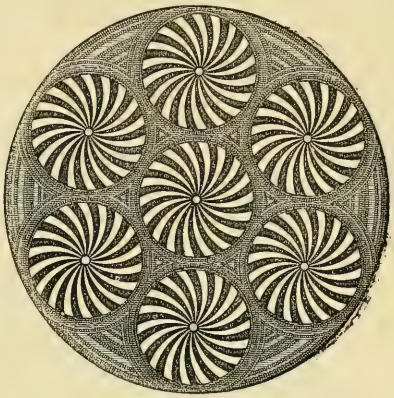


FIG. 2.

The radial stripes in figure 3 disappear, and instead there appears a circle of which the circumference is limited by the centres of the actual circles. Outside this circumference, if the movement be not too rapid, numerous semicircles are seen.

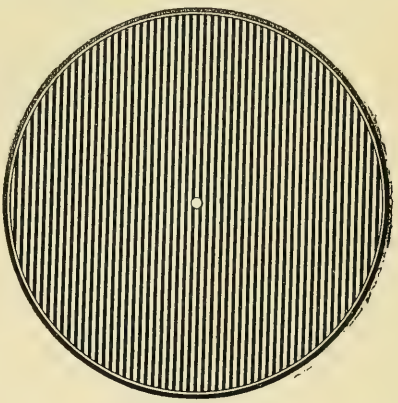


FIG. 4.

On rotating figure 4 on its centre its appearance is completely changed, and the parallel lines are apparently converted into concentric circles.

The figures are one quarter the size of the discs experimented with, and our readers will find the effects much more striking if the figures be drawn to the full size. For the discs 3 and 4 it is only necessary to turn them by hand on a pin, or on the point of a pencil.

THE CITY ARTESIAN WELL BORING.

THE artesian well that the City Commissioners of Sewers are sinking for the supply of their artisan dwellings just off Houndsditch is making slow, but steady, and on the whole, satisfactory progress. The special interest attaching to this work arises from the fact that if it should be found practicable it is the intention of the Commissioners to provide a supply of water not only for the thousand people for whom they have set up model dwelling accommodation, but for various public purposes within the City. That enough will be reached for the supply of the fine blocks of dwellings recently erected by the Corporation there can be no reasonable doubt, since, as a matter of fact, wells have already been sunk in various parts of the City, and have yielded splendid water in quantities quite sufficient for the Commissioners' immediate purpose. But we believe it is an admitted fact that the level of the water in the chalk under London has steadily been going down for many years past; and if anything is to be done for the benefit of the City at large it may be that Colonel Haywood will have to seek a supply deep down beneath the chalk.

The level of the ground on which the boring has been undertaken is about that of the roadway in Houndsditch and the neighbourhood generally; nevertheless, about ten feet of made soil—"shot rubbish"—had first to be gone through, and at a depth of something more than this was found a halfpenny of the year 1862. Some old cellar excavation might possibly account for this, but fragments of Roman tiles, very old crockeryware, and clay pipes of the pattern in which they were made probably at the time of King James's famous "counter-blast," dug up at depths of from eleven to fifteen feet, afford interesting evidence of the gradual rise of surface level at this spot, and since, as it has been said, the surface here is just about that of the surrounding neighbourhood, it shows that the ground on which London stands is now many feet higher than it was generations ago. This fact alone would no doubt be sufficient to account for very important changes in the health of the metropolis of the present day as compared with what it was in the past. The river level of the gravel under London is about seventeen feet eight inches below the existing surface. The well seems to have struck into a dip or pocket in the surface, and in this hollow a human skull was found embedded—washed into it probably long ages ago, when the site of Houndsditch and Bishopsgate and busy Whitechapel was a desolate marshy waste, subject to alluvial action.

Water was touched at 11 ft. 3 in. above Trinity high water mark, and an important part of this undertaking is the stopping out of this surface water. In order to effect this, as the excavation proceeded through the Woolwich and Reading series, huge iron cylinders with an internal diameter of 9 ft. 6 in., and each weighing about four tons, were lowered one on the top of the other, so that the lower ones were driven down by the sheer weight of those above as the digging down below proceeded. There are seven of these great sections of tube now in the well, and these being tightly bolted together form a barrier quite impervious to surface water. The excavation is now going on through the London clay, and here the wall of the well is being constructed of brick, the bricklaying having, of course, to be carried on downwards. When the excavation has got clear of the clay, cylinders will be employed through the Thanet sands and for some distance into the chalk. The present work will terminate with a boring of 100 feet in the chalk. The geological strata underlying London seem to be involved in some obscurity, and it is well known that leading geologists have made one or two serious mistakes in connection with this matter of well boring. Should the Corporation succeed in tapping a copious flow of water it may lead to further experiments of the kind and to the serious discussion of ways and means of utilising the supply.

ABSORBENT QUALITIES OF CHARCOAL.

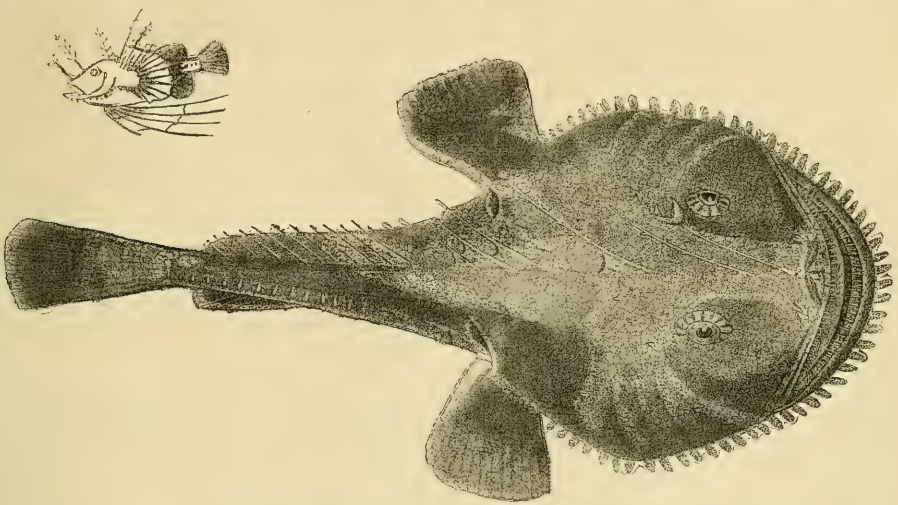
MOST people know that charcoal is largely employed for purposes of filtration, but only a comparative few understand why. From its porosity this material is one of the most powerful absorbents we possess, and, from this property and the ease with which it can be prepared, is of great value both for the absorption of gaseous as well as liquid products of decomposition. The charcoal employed is generally of two kinds, vegetable or animal. The first may be prepared either by the partial combustion of wood in the old rough-and-ready fashion by arranging it in heaps covered with turf and sand, or by the more scientific method of distilling the wood in closed vessels or retorts, whereby the products of distillation, such as wood, tar, water, naphtha, etc., are obtained, as well as the porous charcoal. Animal charcoal is obtained from the partial combustion of bones, and differs from vegetable charcoal in containing a much larger quantity of mineral matter. The absorption of gases by charcoal varies according to the nature of the material from which it is prepared, wood of great density, such as box or cocoanut, generally yielding the most absorptive variety of charcoal. This absorption has been examined by De Saussure, Angus Smith, and Hunter, and the co-efficients of absorption for certain gases are as follows:—One volume of charcoal absorbs 90 volumes of ammonia gas, 85 of hydrochloric acid gas, 65 of sulphur dioxide gas, 55 of hydric sulphide gas, 40 of nitrous oxide gas, 35 of carbon dioxide gas, 9·4 of carbon, monoxide gas, 9·2 of oxygen gas, 6·5 of nitrogen gas, and 1·25 of hydrogen gas. The more readily a gas undergoes liquefaction so does its absorption by charcoal increase, such gases as oxygen, hydrogen, and nitrogen, which are not easily reduced, having a very small co-efficient of absorption. But some gases are not only absorbed by the charcoal, they also undergo a certain amount of decomposition from the air already held in the pores of that material. This is seen to be very markedly the case with such gases as hydric sulphide, or with those derived from the putrefaction of material rich in nitrogen. In the former case the gas becomes converted into sulphur dioxide in a manner analogous to its decomposition during incomplete combustion. After a time the sulphur dioxide undergoes oxidation in the presence of moisture, resulting in the formation of sulphuric acid. Free sulphur can also be extracted from the charcoal by the proper solvents at a certain stage of the absorption.

SHOWER OF ASHES.—On January 5th a shower of ashes fell at Elverum, in central Norway. It is supposed due to a severe volcanic outburst in Iceland, intelligence of which has not arrived.

Natural History.

THE ANGLER OR FISHING-FROG.

Decidedly unprepossessing in appearance, and with a wide-spread reputation for insatiable voracity, the angler or fishing-frog can scarcely come within the category of "things of beauty," but it is nevertheless one of the most interesting of all the regular denizens of our European seas, and it is as curious in its habits as in appearance. Belonging to the order *Pediculati*, the angler (*Lophius piscatorius*), like all the fish of that order, is a bad swimmer, and passes most of its life on the ocean bottom, where the peculiar arrangements of its pectoral and ventral fins enable it to almost walk. It is sluggish and inactive, and but seldom rises to the surface of the sea. It averages about five feet in length, and has



The Angler Fish or Fishing Frog (Lophius Piscatorius).

an enormous head, to which its comparatively little body and tail seem to serve as mere appendages. Its mouth is immensely wide, both upper and lower jaws being furnished with long, pointed, teeth, inclined inwards, which the fish is able to still further depress at will, so as to offer no resistance to the swallowing of large prey. All round its body and head are short fringe-like appendages, and the first three detached spines of its anterior dorsal fin are elongated into long filaments, the first and longest of which bears a kind of little lappet, known as the angler's bait. According to Dr. Günther, this fish possesses the chameleon-like power of assimilating the colours of its body to that of its surroundings, and it is the universally accepted opinion that, by means of this peculiar property, aided by its waving fringes, which bear some resemblance to sea-weed, it is enabled to lie hidden among the stones at the sea-bottom, where it practically earns its living by its own piscatorial exertions, its tufted dorsal spine doing duty as rod and line. Mr. S. Kent, however, strongly opposes this theory, which he condemns as simply a tradition, handed down from Pliny and Aristotle to the present day, and accepted only because no one has taken the trouble to disprove it. He calls attention to the remarkable resemblance of the whole structure of the fish to a submerged rock, its shape, colouring, appendages, etc., all imitating with wonderful fidelity the form, marking, etc., of such a boulder with the natural clothing of vegetable and minute animal growth, and suggests that, in all probability, the angler only lies quietly prone on the ground, and when other fishes approach this natural looking rock to investigate into the possible harvest to be found thereon, simply opens his capacious jaws and "welcomes them in," like the crocodile of "Alice in Wonderland" fame. The angler rejoices in a multiplicity of cognomens—fishing-frog, sea-devil, frog-fish, goose-fish, and monk-fish being some of the most frequently bestowed sobriquets, the two last being of New England origin.

As before remarked, this fish has a most unenviable reputation for inordinate gluttony. The fishermen of the coasts where anglers most do congregate gravely assert that if it cannot get food enough to satisfy the cravings of its extensive appetite, it will not hesitate to eat the cork buoys of the nets, a statement, however, which, we think, must be taken *cum grano salis*, as cork buoys would seem to offer considerable difficulty in the process of digestion, although it certainly is a well-known fact that if a wooden plank be offered to a hungry angler, the fish will instantly snap at it and hang on by its strong, sharp teeth several moments. Couch gives some most astounding proofs of the rapacity of the fishing-frog, commenting at the same time upon its extremely slow digestion. He mentions one instance of an angler in whose stomach were found no less than seventy-five herrings, and another which, on being opened, was found to contain twenty-one flounders and a dory, which, like the herrings in the other case, were forthwith despatched to market, having apparently suffered no deterioration from their

Jonah-like experience. There is another perfectly authenticated record of the finding of seven wild ducks, as part of the internal economy of an angler, and a fishing frog was once seen valiantly attempting to swallow a loon, or great northern diver, whilst others have been known to endeavour to devour cod-fish and conger-eels after they had taken the fisherman's hook, a proceeding which sometimes resulted in a decidedly unusual "catch" for the biped angler. The young fishing-frog is very extraordinary in appearance, the filaments of the dorsal, ventral, and pectoral fins being elongated to a much greater degree than is the case in the mature fish, all the little distinctive fringes being also more strongly accentuated. The British species of the angler, *Lophius piscatorius*, is found all round the coasts of Europe, and occurs sometimes as far south in the Atlantic as the Cape of Good Hope. It is common on the West Coast of North America, where it is found chiefly between Chesapeake Bay on the south, and Nova Scotia on the north, being rarely met with farther north than latitude 60°, and it is especially numerous off Newport, Rhode Island.

Specimens up to 7 ft. in length have been taken in our own seas, and one was caught off Christchurch, Hants, in November last, which measured 5 ft. in length, and weighed 50 lbs. In the Mediterranean, another variety, the *L. budegasse* is frequently found, and on the shores of China and Japan the angler of our own coasts is replaced by a third variety, the *L. setigerous*.

Our illustration has been reproduced by kind permission of Dr. Francis Day, from "The Fishes of Great Britain and Ireland," published by Messrs. Williams and Norgate.

Fire-Flies.—The light of the fire-flies of tropical America seems to be dependent upon the will, as when feeding or asleep it is not seen, attaining its greatest brilliancy during activity and flight. The colour of the light is a rich green, but, according to Dubois, the eggs emit a light of a bluish tint. This naturalist has made extremely interesting experiments with Pyrophorus. The eggs which he dried retained their luminosity for a week, the light re-appearing when they were placed in water. He ground the luminous organs in a mortar, after having dried them in a vacuum, and then mixed them in boiled water, the latter immediately becoming luminous. Dr. Dubois concluded that the light of the Pyrophorus is intended as illumination for itself alone. To prove this, he covered one of the upper lights with wax, and the animal moved in a curve; when both spots were covered the beetle soon stopped and then moved in an uncertain manner, carefully feeling the ground with his antennæ. The spectrum of the light was extremely beautiful, being continuous, without dark or brilliant rays.

The Herring Fisheries.—M. E. Marbeau gives, in the *Review Francaise* and in *Cosmos*, the following account of the annual migration of the herring:—"From July 1st to 20th the fish are to be found from 20 to 30 leagues off the southern portion of the Shetland Islands, between 57° and 60° N. latitude. From July 20th to August 20th, opposite the coast of Scotland, between Aberdeen and Leith, N. latitude 56° to 57°. From August 20th to September 5th, along a line parallel to and 50 to 70 miles off the coast between Edinburgh and Newcastle, N. latitude 55° and 56°. From September 5th to October 15th, to the north-east of Hull, along the Dogger Bank, N. latitude 54° and 55°. From October 15th to November 1st, about the Swarte, Broken, Well, Ower, and Leman banks, and at the beginning of the Gabbard bank, from 52° to 53° N. latitude. In the space between the Haddock and the Sheringham banks, at some miles off the English coast, a considerable quantity of herrings may always be found from October 5th to 20th. From November 1st to 15th, from 5 to 15 miles off the Ruytingen bank, opposite Dunkerque. From then to February 1st, from two to four miles off the French coast from Cape Gris-Nez past Boulogne, Etaples Vergyer, Platiers, and as the season advances, opposite Berck, Dieppe, and Fécamp. During February the herring becomes increasingly rare.

Male Animals Yielding Milk.—Dr. Maitz Alsberg (*Humboldt*), referring to a he-goat now living at Wenigensommern, near Erfurt, which yields milk very similar to ordinary goat's milk, but rather richer, remarks that both in man and in all mammalia a time must have existed when both sexes were equally capable of yielding milk. This time is probably not very remote.

A Giant Toad.—According to the *Temps*, a toad has recently been found at Juiltac, in the department of the Corrèze, weighing 66 lbs., and measuring nearly three feet round the body. Its croaking is said to resemble the barking of a dog. Our readers will kindly remember to take this announcement with the proverbial "grain of salt."

Electric Actions in Plants.—M. Donnée has been recently exploring the electric conditions of fruits by means of a delicate multiplier. He finds that from the pith of the cambium the successive layers of a tree becomes less and less positive, whilst from the cambium to the outer layer of the bark positive electricity again increases.

Bird-eating Frogs.—"Ubique" communicates to the *English Mechanic* an instance of a bull-frog swallowing a sparrow, at Hazareebagh, in Bengal. The sparrow was heard uttering cries of distress, and the frog was found with the tail and feet of the bird sticking out of its mouth. By the next morning these had disappeared. This reminds us of a case from South Africa which came to our knowledge, where a sugar-bird was rescued only just in time from the jaws of a large frog.

Insects Simulating Minerals.—Mr. E. B. Poulton, who has been engaged for some time in studying the manner in which certain butterfly-pupæ assume the colour of the surfaces to which they are attached, thinks it probable that the gilded pupæ of the Vanessa group (from the appearance of which the word chrysalis takes its origin) resemble glittering minerals, such as mica. It is further to be noted that their shape is very angular, resembling minerals. On the other hand, grey pupæ resemble grey and weathered rock-surfaces. Mr. Poulton finds no evidence that these assimilations in colour have been effected by anything like photographic action.

Embryology.—At a meeting of the Philadelphia Academy of Natural Sciences, Professor Ryder described a ring-like prolongation of the placenta in embryo mice and rats as indicating the descent of these animals from lower types in which the placenta was zonary.

Spider said to Feed on Zinc Sulphate. — Captain T. P. Battersby, writing in the *English Mechanic*, quotes with strong doubt the following statement from an old work on chemistry: "It has been discovered by Mr. Holt, the Secretary of the Cork Society, that spiders will feed upon sulphate of zinc. One of these insects, kept in a box for six months was found to have eaten nearly 4 ozs. of the salt." See Thomson's "Annals," vol. xii., p. 454. If this is a fact, not merely our biology, but our chemistry will stand in need of a serious revision. But we may mention that spiders are perfectly capable of fasting for six months.

Return of Birds of Passage.—Mr. H. Kerr, of the *Newcastle Weekly Chronicle*, mentions that the migrating birds are this season putting in an early appearance on the south coast. If this phenomenon is general, it refutes the traditional notion that birds, whilst in their winter retreats, have some mysterious knowledge of the kind of weather prevailing in their summer haunts, and accelerate or postpone their return accordingly.

The Badger not Harmless.—Mr. J. D. Aysh (*Field*) gives an instance of a badger shot in a fowl-house in the very act of devouring a brood-hen which he had killed.

Lions Bred in Captivity.—According to Mr. W. B. Tegetmeir, 131 lion cubs have been produced in the Dublin Zoological Gardens, of which 110 have been reared, realising for the society £3,117.

Intelligence of a Pelican.—According to a work recently published by Madame Clemence Royer, a tame pelican, which lived at St. Domingo, in a fisherman's family, and received for its food the offal thrown away in cleaning out the fish. It went every day to the shore to meet the boats on their return. But as the fisherman observed the Sunday's rest, the bird acquired in time a precise notion of this weekly fast, and remained sitting on its perch philosophically waiting for its repast of the next day. *Le Voltaire*, quoting this incident, says, "There exists no satisfactory definition of instinct, because this expression represents nothing definite."

Preservation of Otters.—Among naturalists of the "aberrant" type, *i.e.*, that is, those who approximate to the sportsman, there is at present no little controversy as to whether the otter should be extirpated as an enemy to fish, or spared as a destroyer of some of the chief enemies of the salmon and the trout? The character of the heron, too, is under discussion.

How to Seize Wasps and Bees without being Stung.—*Cosmos* quotes from *Science* the assertion that if, on seizing a wasp or a bee, we take the precaution not to breathe, the capture may be effected with impunity and without any protest on the part of the insect. A correspondent of the latter paper states that, according to his personal experience, this is quite correct as far as wasps are concerned. But in the case of hive-bees, wild bees, and hornets the precaution is of no use.

Voracity of the Bull-Frog in India.—According to *Eos* (*Field*), this frog gobbles up young ducks and is very greedy of small fishes. Hence he cannot, like his European kindred, be protected as a harmless and even useful animal.

FUNDAMENTAL EXPERIMENTS ON THE NUTRITION OF PLANTS.

We propose to give plain instructions for the repetition of some of the cardinal experiments of vegetable physiology, selecting those only which can be successfully carried through with simple apparatus and moderate experimental skill. Glass vessels of ordinary forms, common chemical reagents, and a tolerable balance will, as a rule, suffice. No unusual manipulative skill is demanded, but merely that attention to minute detail which all scientific experiment requires. The reader who may desire fuller information on these and other points of the physiology of plants is recommended to refer to Sachs' or Vines' lectures. "Detmer's Pflanzenphysiologische Praktikum" is an excellent manual for those who read German, and we have turned it to account in preparing these instructions.

Experiment 1.—*Proof of the formation of organic substance out of inorganic material by green plants.*

Take dry beans or maize. Grind a few in a small mortar to fine flour. Place some of the flour in a small cup, weigh the cup and flour together with great care. Dry at a temperature of 100° C. for half an hour in a water-oven, and re-weigh, thus determining the proportion of water in the seeds. Then select a few perfect seeds, weigh exactly, place in distilled water until they sprout, wash with more distilled water, and then rear by water culture.

Water culture is managed as follows: A tall cylindrical glass vessel, holding from one litre to a litre and a half (such a vessel would be about a foot high and 2 to 3 inches in diameter) is fitted with a sound cork about ¾ inch thick. A hole is cut in the centre of the cork, large enough to take very easily the stem of the plant under experiment; the cork is then halved for convenience in removing and replacing the plant. The plant is to be held in place by a loose packing of cotton wool. The roots are allowed to dip into the solution, which fills the cylinder to within half an inch of the cork. Experiments are usually carried on in a window where sunlight enters freely. To prevent the growth of microscopic vegetation in the nutritive fluid, the cylinder is cased in black paper, but as this would cause over-heating, if black outside, care is taken to blacken the paper on one side only, and to turn the white side to the light.

A good nutritive fluid is made as follows:—

Calcium nitrate	.. ..	1 gramme.
Potassium chloride	.. ..	·25 „
Magnesium sulphate	.. ..	·25 „
Potassium phosphate (KH_2PO_4)		·25 „
Water	.. .. ..	1 litre.

Add to the mixture a few drops of dilute solution of iron chloride. It is convenient to mix a large quantity, and keep it in well-stoppered bottles in the dark.

The soaked seeds must now be fixed, each in a separate cylinder. The top of the roots must reach the water, and the cotyledons within the seed-coats must be kept in an atmosphere saturated with moisture, but not actually immersed. A loose net made of threads knotted together at one place is sometimes convenient for suspension of the seed. As the fluid is absorbed, fill up with distilled water. At intervals of two or three weeks, replace the fluid by fresh solution. It is desirable to take out the plants occasionally and lay their roots in distilled water

for a day. With care and under favourable conditions, large healthy plants may be grown in this way. When grown to a suitable height, the plant must be removed, cut up small, with scissors, dried at 100° C., and weighed. The result of the experiment may be set down in this form :—

Weight of seed ... ... —
Of which the water, driven off at 100° C., amounted to ... ... —
Weight of plant after — weeks' cultivation —
Weight of plant, dried at 100° C. ... —
Increase of organic substance at the expense of inorganic material ... ... —
Being — times the original weight.
(The mineral constituents may be neglected.)

If a plant, grown from the seed under the above conditions be kept in the dark, it never acquires a green colour. Dry and weigh it after some weeks, when its weight will be found to fall considerably below that of the original seed. Waste by oxidation has gone on steadily, and there has been no formation of new organic substance.

Experiment 2.—*Proof that green plants liberate oxygen under the influence of light.*

Enclose a number of green water-weeds in a glass funnel, which rests, mouth downwards, in a beaker of water. Invert a test tube, completely filled with water, over the funnel. Place the apparatus in sunlight. Bubbles of gas arise from the plants, and collect in the test tube. When the tube is sufficiently full, place the thumb against its mouth, withdraw the tube from the beaker, and gently turn it mouth upwards. The presence of abundant oxygen can be proved by inserting a glowing match.

If it is desired to collect the oxygen rapidly and in considerable bulk, the water in the beaker should be aerated occasionally, but not profusely, with a carbonic-acid generator.

Experiment 3.—*Proof that green plants can only liberate oxygen when supplied with carbonic acid.*

Place green water-weeds in a flask which is fitted with a cork. Pass through the cork a glass tube connected with a V-tube, in which are fragments of pumice moistened with caustic potash solution. The potash is used to absorb the carbonic acid from the air, which is allowed to pass freely into the flask. Expose to sunlight. At first bubbles of oxygen will be seen to pass off from the weeds, but with steadily diminishing rapidity. After a few hours no more will form.

Experiment 4.—*Proof that starch is precipitated in green leaves under the influence of sunlight, and that it disappears in darkness.* (Sachs' experiment.)

Take a broad leaf, such as primrose or tropæolum, which has been exposed to sunlight for some hours. Discharge the green colour by boiling in water, and afterwards in methylated alcohol. Prepare a sherry-coloured solution of tincture of iodine in water. Pour this into a white saucer, and place the blanched leaf in it.

Repeat the experiment with a leaf of the same species which has been kept in the dark for some hours. The second plant may be kept covered with a flower-pot, while the first is being exposed to light.

The first leaf will exhibit dark purple blotches, indicating the presence of starch, wherever the light has acted. No such coloration will appear in the second leaf.

Half of a leaf may be shaded by a paper envelope, while the other half is freely exposed. An equally marked difference in colour will be observed when the leaf is blanched and iodized. Hence we learn that the assimilating action of the light is not communicated, even to neighbouring parts of the same leaf, and that the precipitated starch remains in the cells where it was formed.

Experiment 5.—*Proof that starch is precipitated in green leaves only when carbonic acid is present.*

Place a bell-glass in a dish containing potash solution. Within the bell-glass, a green plant, *e.g.*, a primrose in a pot, is to be placed, care being taken that the pot does not touch the potash solution. Expose the whole apparatus to sunlight, and after some hours test a leaf for starch, as in Experiment 4. No purple patches will appear.

This experiment is sometimes modified by exposing half of a leaf to sunlight in the presence of carbonic acid, while the other half, still attached, is kept in an atmosphere devoid of carbonic acid. Starch is precipitated in the first half but none in the second. (Moll's experiment.)

Experiment 6.—*Proof that green plants form proteids (organic nitrogen-compounds) out of inorganic nitrogen-compounds.*

Seeds of maize are germinated, and grown by the method described under Experiment 1. If the nitrate is left out, the plant is starved, and attains only a very small size, never forming any new proteids, but merely using up those contained in the seed. Incidentally, this experiment shows that the plant is unable to use as food the abundant free nitrogen of the air.

By a variation of the same experiment, it can be shown that potassium is necessary to active growth. If a sodium-salt be substituted, the vigour and size of the plant are very materially affected.

Water-culture is the chief resource for investigation of the processes of plant-nutrition, and the student who intends to work seriously at vegetable physiology will find an ample reward for any time and pains spent upon this somewhat difficult mode of experiment.

Reviews.

Geology, Chemical, Physical, and Stratigraphical. By Joseph Prestwich, M.A., F.R.S., F.G.S. Vol. ii. : Stratigraphical and Physical. Oxford : Clarendon Press.

This volume, though nominally a continuation of the author's previous work, is quite complete in itself as a geological history and record of biological evolution from the time when life first made its appearance on the earth's crust. The great physical changes that have taken place from the Archæan to Post-glacial periods, together with the development and successive modifications of life, are carefully detailed. Firstly, as represented in this country, and secondly, at the end of each geological period, we have the corresponding systems of Europe and other parts of the world sufficiently identified and enlarged upon to enable the reader to enter into the wider consideration of stratigraphical geology, should he so desire. At the end of each of the greater geological

divisions are given delicately lithographed plates of the characteristic genera of each group of Invertebrata as represented in the greater periods, whilst the text is profusely illustrated by figures of the more important species characterising the several lesser divisions or formations, which together with the large and carefully executed geological map of Europe attached to this volume simplify and accentuate the teachings of what is perhaps one of the most complete and lucid geological histories of the day.

We note that Professor Prestwich is very averse to admitting that the Breccia of the Permian Strata were deposited by the agency of ice, and his suggestion that the grooves and striations often found on the rock-fragments may be really slickenside surfaces and not glacier striations, is deserving of consideration; but when it is remembered that many of these angular rock-fragments weigh several tons, and have been transported from forty to fifty miles from the parent rocks, it certainly seems a more plausible theory than that these strata should have been formed by what may be termed waves of translation, which is the theory Professor Prestwich favours.

With reference to the probable duration of the accessible coal measures of Europe, it is interesting to note that a Royal Commission on which the author served decided that at the present annual rate of consumption (1871) there was sufficient coal to last 1,273 years, but allowing for the rapidly increasing rate of consumption, the period may be reduced to 324 or 433 years, even allowing for being able to work coal at a depth of 4,000 feet, the greatest depth at present worked being about 3,000 feet. Professor Prestwich shows clearly that the Globigerina Ooze deposited in the Atlantic is not homologous with the chalk as at first was contended, although it contains many calcareous Foraminifera which occur fossil in the chalk, and the abundance of siliceous Lithisted and Hexactinellid sponges attached by fine rootlets to the surface of the Ooze presents another point of analogy with the chalk, but as a matter of fact the great bulk of the forms discovered on the "Challenger" expedition are only distant analogies of the extinct forms, and considering the bathymetrical limits to the growth of existing sponges it appears impossible that the chalk can have been deposited at the depth at which the Globigerina Ooze is found. The more abstract, physical, and cosmical problems have been relegated to the concluding chapters, but they are by no means the least interesting part of the author's contribution to the science of geology, owing to the uncompromising way in which theories are confronted by hard geological facts—a most time-saving method of dealing with theoretical questions.

*The Fresh-water Aquarium and its Inmates. A Guide to the Arrangement and Care of Freshwater Aquaria.** By Dr. W. Hess, Professor in the Royal Technical High School of Hanover. Stuttgart: Ferdinand Enke.

The aquarium, or aqua-vivarium, as it should more correctly be named, exists in two legitimate forms. It is either a portable apparatus for the observation of water-plants and animals, capable of being placed in a study, a laboratory, or a conservatory, or it is a structure for the same purpose on a large scale fitted like those of Naples, Roscoff, etc. Dr. Hess treats here exclusively of the portable aquarium, that on the larger scale being for the most part beyond the reach of private persons. The author confines himself also to fresh-water aquariums, those for sea-plants and animals being more difficult to manage, especially in inland places. We find here, firstly, very clear instruction for the installation, fixing, filling, and management of an aquarium, of whatever shape and size. Due emphasis is laid upon the quality of the water, upon a proper proportion of animal and vegetable life to each other, and to the size of the tank; upon aeration, the removal of dirt from the bottom, the regular but not excessive feeding of the zoophagous animals, the avoidance of excessive light and heat. For want of attention to such points many aquariums, as we have from time to time the pain of observing, become neither instructive nor ornamental, but simply nuisances, collections of dead or dying plants and animals in polluted water. The use of certain water-snails in browsing away the tender green algæ which are otherwise apt to attach themselves to the glass and render it opaque, is here mentioned. The caution is given that if decomposing matter, *i.e.* the dead leaves of plants, the cast-off skins of the animals and their excreta, is allowed to accumulate at the bottom of the tank, one unpleasant consequence will be a wonderful multiplication of infusoria. Interesting as these creatures are as microscopic objects, they are preferably kept in a separate glass, since they rob the water of oxygen to a degree injurious to the larger animals.

An exceedingly elegant and commodious combination of an aquarium and terrarium is here described and figured. Around the top of an aquarium, which might, as far as the principle is concerned be of any shape, is fixed a tray extending outwards on all sides, so as to form a sloping shore. This tray is covered with sand, pumice, rock-work, and moss, and forms a snug semi-aquatic retreat for tortoises, salamanders, etc.

The plants and animals suitable for an aquarium are described, in most cases figured. In every case the temperature, food (where animals are concerned), and other conditions are laid down. We can strongly recommend this book to all lovers of water and swamp-plants and animals if they read German. The better an aquarium is managed the more novel and accurate observations can be made on the life-history of its inhabitants.

Geometry in Space, containing parts of Euclid's 11th and 12th Books, and some Properties of Polyhedra and Solids of Revolution, with Exercises. Clarendon Press Series. Edited by R. C. J. Nixon, M.A. Oxford: Clarendon Press.

The author believes that the study of geometry in space, as distinguished from geometry of two dimensions only, is of great value, both as a mental discipline, and from a utilitarian point of view. He treats of planes and solid angles, of polyhedra and solids of revolution. An appendix is subjoined on the perspective of solids. The whole treatise may be considered as a third part of the author's "Euclid Revised."

SANITARY VALUE OF SALT.—A writer in the *Newcastle Weekly Chronicle* contends that the scarcity of salt and the want of a saliferous atmosphere are among the prominent conditions of unhealthy climates. He instances the low sanitary condition of Siberia, where salt is excessively dear and where the salt-bearing sea-breezes are excluded. He considers that the prevalence of leprosy among the poorer classes in India is due to the high price of salt.

* "Das Süsswasser aquarium und Seine Bewohner. Ein Leitfaden für die Anlage und pflege von Susswasser aquarium."

Abstracts of Papers, Lectures, etc.

INSTITUTION OF CIVIL ENGINEERS.

At the meeting on the 24th of April, the President, Mr. Bruce, being in the chair, the paper read was on "The Distribution of Hydraulic Power in London," by Mr. Edward Bayzand Ellington, M. Inst. C.E.

The author observed that water-power was no new force, but that, as formerly understood, it was limited in its application to systems of mechanism suitable for the low pressures found in Nature. The effects obtained by the use of high pressure were so different in degree from all previous experience that a new name was needed and had been found in the term "Hydraulic Power." Bramah's genius produced the hydraulic-press, and he clearly foresaw the future development and great capabilities of his system; but it was reserved for Lord Armstrong to work out and superintend the intricate details that had to be developed before the system could be made fully serviceable. The public supply of hydraulic power in London constituted the latest development of this system. The hydraulic power was supplied through mains charged by pumping at a pressure of 700 lbs. per square inch. The first and largest pumping-station had been erected on a site known as Falcon Wharf, about 200 yards east of Blackfriars Bridge. The engine-house at present contained four sets of pumping-engines, each set being capable of exerting 200 indicated H.P. The engines were vertical-compound, of a type comprising the advantages of a three-throw pump with direct connection between the pump-plungers and the steam-pistons. Each set of engines would deliver 240 gallons of water per minute into the accumulators, at 750 lbs. pressure per square inch, at a piston-speed of 200 feet per minute. This was the normal speed of working, but when required they could be worked at 250 feet per minute, the maximum delivery being 300 gallons per minute. The condensing water was obtained from storage-tanks over the engine-house, and was returned by circulating-pumps to one or other of those tanks. The water delivered into the mains was maintained all the year round at temperatures of between 60° and 85°. The boilers were of the doubled-flued Lancashire type, and were made of steel. The reservoir of power consisted of accumulators. The accumulators at the pumping-station were two in number, each having a ram 20 inches in diameter, and of 23-feet stroke. The weight-cases were of wrought-iron, and were filled with iron slag. The total weight of the case and load on each ram was approximately 106 tons, corresponding to a pressure of 750 lbs. per square inch. The storage-tanks formed the roofs for the engine and boiler-houses. The water for the power-supply was obtained from the River Thames, and was pumped into the tank over the engines. The water passed through the filtering-apparatus by gravity into the filtered water-tank over the boiler-house, which was 7 feet below the level of the unfiltered-water tank. The filters consisted of cast-iron cylinders, and each contained a movable perforated piston and a perforated diaphragm, between which was introduced a quantity of broken sponge; the sponge was compressed by means of hydraulic pressure from the mains. The delivery of power-water from the Falcon Wharf pumping-station was through four 6-inch mains. The most distant point of the mains from the accumulators was at the west end of Victoria Street, and was 5,320 yards, or just over three miles. To provide for all frictional loss in the pipes and valves, the accumulators had been loaded to 750 lbs., the stated pressure supplied being 700 lbs. per square inch. The total length of the mains at present laid was nearly twenty-seven miles. The mains were laid in circuit, and there were stop-valves at about every 400 yards, so that any such section of main could be isolated. The method employed for detecting leakage was based upon an automatic record of the number of gallons delivered into the mains, and in cases of abnormal increase during the night, if found to arise during the early hours of the morning, the mains were tested. The power-water used was invariably registered through meters on the exhaust-pipes from the machines, and from the meters passed to the drains. There was a sliding-scale of charges from 8s. to 2s. per 1,000 gallons at 700 lbs. pressure per square inch, designed to meet, as nearly as possible, the variable conditions and requirements of consumers. The more continuous the use, the lower the charges. The scale was intended chiefly for intermittently-acting machinery, and experience had fully proved that these rates were sufficiently low to effect a large saving to the consumer in almost all cases, whether for a large or small plant. The author believed any idea of supplying power from a central source, at rates much below these, to be chimerical. The practical efficiency of the hydraulic system might be fixed at from 50 to 60 per cent. of the power developed at the central station. No other method of transmission would, to say the least, show a better result; and the general convenience and simplicity of the hydraulic system was such that its use would hardly be affected, even if there were no direct economy in the cost of working.

In addition to the general supply of hydraulic power, in the City and adjoining districts, to the six hundred and fifty machines at present worked, a new departure had been taken by the application of hydraulic power to an estate at Kensington-court, the name given to an area of about seven acres facing Kensington-gardens. Seventy houses and dwellings were to be built on this estate, of which thirty had been already erected. Each house was fitted with a hydraulic lift, taking the place of a back staircase, and the power-supply was provided on the estate expressly for working these lifts. The driven machinery was as of great importance to an economical and satisfactory result as the distributing-plant, but this obvious fact was not always understood. General regulations had been prepared by the author, defining the conditions to be observed by manufacturers in fitting up machinery for connection to the power-mains. They were intended to secure safety, and an efficient registration of the quantity of power used; but they left the question of the economy and of the efficiency of the machines to be settled between the consumers and the makers. In London more lifts were working from the mains, and more power was used by them, than by any other description of machinery. The number of all classes at present at work was over four hundred. The principal types in use were fully described. In some cases there had been, by adopting the public supply, a saving in the cost of working of about 30 per cent., as compared with the steam pumping-plant previously in use. Lifts were now becoming so general, and the number of persons who used them was so great, that the author considered it necessary to urge the importance of

securing the greatest possible safety in their construction by the general adoption of the simple ram. Suspended lifts depended on the sound condition of the ropes or chains from which the cages hung. As they became worn and unreliable after a short period, it was usual to add safety appliances to stop the fall of the cage in case of breakage of the suspending ropes, but they could not be expected to act under all circumstances. As an indication of the important part which lifts occupied in a modern hotel, it might be mentioned that at the Hôtel Métropole there were, including the two passenger lifts and that for passengers' luggage, no less than seventeen hydraulic lifts in use day and night, while the work done represented about 2,000 tons lifted 40 feet in this time. The next largest use of the power was for working hydraulic cranes and hoists of various kinds along the river-side, and in the City warehouses. It often happened that the pressure in the power-mains was not sufficient for pressing-purposes. The apparatus known as an intensifier was then used, by which any pressure required could be obtained. Hydraulic power was also used at Westminster Chambers, and elsewhere, for the purpose of pumping water from the chalk for domestic use. The pump was set going in the evening and continued working till the tanks were full, or until it was stopped in the morning. For work of this kind, done exclusively at night, a discount was allowed from the usual rates. Mr. Greathead's injector-hydrant, made at the Elswick Works, had been in use to a limited extent in London in connection with the power-mains. A small jet of high-pressure water, injected into a larger jet from the waterworks mains, intensified the pressure of the latter in the delivery hose, and also increased the quantity. By this means a jet of great power could be obtained at the top of the highest building without the intervention of fire-engines. This apparatus enabled the hydraulic power supply to act as a continuous fire-engine wherever the mains were laid, and was capable of rendering the greatest assistance in the extinction of fire; but there was an apathy on the subject of its use difficult to understand. In Hull, the Corporation had put down a number of these hydrants in High-street, where the hydraulic power-mains were laid, and they had been used with great success at a fire in that street. The number of machines under contract to be supplied with power was sufficient, with a suitable reserve, to absorb the full capacity of the station at Falcon Wharf, and another station of about equal capacity was now in course of erection at Millbank-street, Westminster. The works had been carried out jointly by the author and Mr. Corbet Woodall, M. Inst. C.E.; Mr. G. Cochrane had been resident engineer and superintendent. The pumping-engines, accumulators, valves, etc., and a considerable portion of the consumers' machinery, had been constructed at the Hydraulic Engineering Works, Chester. Sir James Allport, who was the first to adopt hydraulic power for railway work, had been associated with the enterprise from the commencement of its operations in 1882. His wide influence and extended experience had greatly assisted the commercial development of the undertaking.

EDINBURGH GEOLOGICAL SOCIETY.

The first communication at the meeting on April 19th was by Mr. H. M. Cadell, of Grange, on "The Geology of the Forth Bridge district." Having first described the "solid geology" of this part of the Firth of Forth, he pointed out that the calciferous sandstone series to which the strata at Queensferry belonged were composed chiefly of sandstones, with non-bituminous and bituminous or oil shales. One of the oil shales, corresponding in position to the Broxburn shale, had been mined for several years by the Dalmeny Oil Company. There were other oil shales lower down in the series which had not yet been worked in the district. The piers supporting the girders of the Forth Bridge at South Queensferry were founded on a platform of strong sandstone, which Mr. Cadell correlated with the sandstone at Binnie and Humbie farther south. The sedimentary strata had been invaded by great sheets of igneous rock, which in this locality was a typical coarse diabase, thin slices of which were exhibited under the microscope to the Society. These hard eruptive rocks gave rise to all the conspicuous hills in the vicinity, and supplied an excellent foundation for the great cantilever piers on Inchgarvie and the north shore. The author then went on to speak of the surface geology of the district. All the hard rocks of the district, he said, bore the marks of intense ice action, and there were indications of a general easterly movement of the ice sheet that once filled the Forth. The boulder clay formed the foundation of the south cantilevers. It was a very hard and strong foundation, and the author thought that, so far as foundations at least were concerned, there was no danger for the stability of the bridge. Professor W. Ivison Macadam exhibited a collection of gold and silver ores from the Ohinemuri or Upper Thames, and other mine districts of New Zealand. In some notes accompanying the exhibits, it was explained that the tin ore was taken from a reef extending for some two miles of country, and running from three to fifteen feet thick. The silver in this ore was said to exist chiefly as chloride with some iodide. While remarking that he had not verified the latter statement, the author considered that in many of the ores the silver existed partly as silicide. Owing, however, to the mixed character of the stone, he supposed that this must remain an open question. In view of the unlikely appearances of some of the ores exhibited, they would, it was remarked, be astonished at their richness. Some had come into the author's possession giving 1,000 ozs. avoir. of silver to the ton of 2,240 lbs., and 6 ozs. of gold; but, of course, it would be apparent to them that such heterogeneous material must greatly vary. Nothing had been done in the way of working the heterogeneous ores of the nature of some of the specimens sent. There was also on exhibition a specimen of scyelite from Reay, Caithness, shown by the secretary.

JUNIOR ENGINEERING SOCIETY.

Two papers, "On Boiler Feeders," and "On the Elasticity of Materials," by Mr. S. Boulding, Grad. Inst. M.E., and Mr. F. R. Taylor, respectively, were read at the last meeting of this society. A rapid survey was made of the history of boiler feeders, commencing with Savery's engine, and including Boulton and Watt's automatic feeder. The several objections to the use of the feed pump were enumerated, and Giffard's invention of injecting water into the boiler, by means of a jet of steam from it, was mentioned as constituting the principle upon which the existing modified constructions were based, as exemplified in the automatic, exhaust steam, and inspirator injectors. The author pointed out that the use of exhaust steam was not to be commended. It acted

in a detrimental manner on the boiler, in consequence of the cylinder lubricant being carried with it, and precipitating on the plates. A specimen of Hancock's inspirator was exhibited and described. Results of working given showed delivery at various pressures and lifts. In respect to the elasticity of materials, the author of this paper considered that point of reference of structural materials should be the elastic limit, in preference to the ultimate breaking strain. The need of reliable data as regards the strength and behaviour of materials was urged. Hooke's law was dwelt upon at some length, and on the conclusion of the reading of the papers an interesting discussion ensued, in which Mr. Tennant, Mr. W. Dunn, and Mr. P. Marshall took part.

ROYAL METEOROLOGICAL SOCIETY.

At the monthly meeting held on the 18th ult., Dr. W. Marcet, F.R.S., President, in the chair, the following papers were read :—

1. "Jordan's new pattern Photographic Sunshine Recorder," by Mr. J. B. Jordan. The improvement in this instrument over the previous pattern of Sunshine Recorder consists of two semi-cylindrical or D-shaped boxes, one to contain the morning and the other the afternoon chart. An aperture for admitting the beam of sunlight is placed in the centre of the rectangular side of each box, so that the length of the beam within the chamber is the radius of the cylindrical surface on which it is projected ; its path therefore follows a straight line on the chart at all seasons of the year. The semi-cylinders are placed with their faces at an angle of 60° to each other. They are fixed on a flat triangular plate which is hinged to a suitable stand, having levelling screws attached, and fitted with a graduated arc as a means of readily adjusting, and fixing the cylinders to the proper vertical angle agreeing with the latitude of the station where used.

2. "On the Meteorology of South-Eastern China in 1886," by Dr. W. Doberck, F.R. Met. Soc. This paper gives the results of observations made at the custom-houses and lighthouses by officers of the Imperial Chinese Maritime Customs. In summer there is very little change of temperature with latitude. The temperature depends upon the distance from the nearest sea coast, and is greatest at stations farthest inland. The highest mean temperature occurred in July, and the lowest in January. The North-east monsoon blows from September to June, and the South monsoon during July and August ; the latter does not blow with half the force of the former. Rainfall is greatest in Northern Formosa, and least in Northern China. Along the east coast of Formosa and Luzon the winter is the wet season, while in China July seems to be the wettest month of the year.

3. "Lightning in Snowstorms," by Professor A. S. Herschel, F.R.S.

4. "Insolation," by Mr. Rupert T. Smith, F.R. Met. S.

ARISTOTELIAN SOCIETY.

On April 23rd, Mr. Daphne read a paper on "Some Conscience Theories." Following an analysis of the notions involved in the contrasted terms, "Fact" and "Right," he drew attention to the two independent questions involved in any inquiry into the genesis of "Conscience," viz. : that of the genesis of the various existing rules of conduct (which could often be traced), and the genesis of the partly intellectual, partly emotional, state called conscience, which was not so capable of demonstration. He considered the view taken by Professor Bain, in his book on "The Emotions and the Will," that its germ is fear, induced by punishment, unsatisfactory, since it involved the assumption that disinterested and even self-sacrificing acts, from the prompting of which both fear and hope of praise were admittedly absent as motives, nevertheless arose from a germ of which fear was the solitary characteristic. He doubted whether any satisfactory scientific theory of the genesis of conscience was to be expected, but inclined to consider it more akin, so far as feeling was concerned, to the discomfort felt at being out of correspondence with surrounding relations.

AGRICULTURAL EDUCATION AND DAIRY INSTRUCTION.—II.

Abridgement of Paper read at the Society of Arts by Mr. John Wrightson, M.R.A.C., F.C.S.

(*Concluded from page* 405.)

NOW, how are we to give the maximum benefit to a man whose life is to be spent in successfully managing a farm without a bailiff, so as to make his business pay, maintain a family, and keep up the high character for skill and knowledge of his business now possessed by the British farmer ? I hope my hearers know the man. I have known him for upwards of thirty years. He is healthy, hardy, skilful, judicious, combative, respectful, acute, and thoroughly well up in his business. All are not so, but I say advisedly, that our farmers are a grand set of men, holding their own through long years of depression, ever hoping, ever striving, ever cheerful. He is the very man to beget a son in his own image, and you cannot look at the rising generation of our farmers without seeing that they will follow on in the same straight line. Gentlemen, let me tell you one thing with reference to teaching these men their business—if you want to teach them anything about land, or stock, or crop, or market, you must begin with them when they are very young ; otherwise you will find that the tables are turned, and that they are, in many cases, wiser than their teachers. Again, I ask how are we best to equip these young men for their business ? I unhesitatingly reply—by giving them a sound, general education, and leaving the rest to their fathers. Do you suppose that any agricultural professor can instruct these youths as well as a thoroughly experienced farmer ? If so, I can tell you that the professors learn what they know of practice from the farmers. The more a professor of this art mixes with farmers, and hears their views, the better teacher he will be. Scientific instruction, to be worth anything, must be controlled, checked, modelled upon practice, and no teaching is worth attending that does not carry with it the impress and the sanction of practice. The British farmer is an adept in his business, and it is a difficult matter to improve him. A sound education and a period of pupilage at home, or with another good farmer—or both. Or, in addition to this, a year or two in a commercial office or bank—as is the excellent system pursued in Scotland. Or, in other cases, a year or two at an agricultural college, when the parents can afford the time and the money.

Farmers are not much taken up with the idea of

collegiate instruction. They mistrust it, and do not think that the knowledge gained at such colleges will compensate for the time required in gaining it. I will not say that an agricultural college might not be of great value to a farmer, but I will say this much—that no agricultural professor can compete with a thoroughly typical, well-informed, and successful farmer in knowledge of the art. There are two, or more, ways of looking at this question. If you wish to make a man a good and successful farmer, he cannot obtain the necessary knowledge so well as among farmers. If you want him to rise out of his class—to be able to talk, to make speeches, to discuss points, and attain a certain reputation as a talker and writer, whereby he may advance his own ends—then, I grant that a college training will greatly assist him. It is, however, open to doubt whether it will enable him to fatten a bullock, to grow a crop, or to make his farm pay better. It must, however, be allowed that the man who can arrange and express his ideas is, in these days, much more likely to push his way; and, therefore, a college training may be of the utmost use to a young man, and its sequel may easily be an improved social and professional position. Such a result is, however, only for the few. I have been connected with agricultural colleges for twenty-five years, and can testify to the exceedingly small number of men—not, I am convinced, one in five hundred—who climb the ladder of fame by taking advantage of the opportunities afforded of scientific knowledge in connection with agriculture. We are, therefore, thrown back upon the usual practical result that the good practical farmer grows as good crops, fattens as much beef and mutton, and arrives at as good general results, as the man who has enjoyed all the advantages of scientific instruction.

Travelling Instructors.

For the benefit of those actually engaged in dairy farming, the system of travelling instructors is well worthy of attention. The agent to the Duke of Portland (Mr. Turner) stated that at the great Kilmarnock Show in 1884, previous to their engaging Mr. Drummond, the itinerant lecturer, Ayrshire cheese-makers only secured £5 in prizes in the open classes. The next year, the first in which instruction was given, they secured £45; in 1886, £76; and in 1887, £156. The Highland Agricultural Society gives an annual grant to different counties for this purpose, and the results have been most satisfactory. Instruction of this kind given on the spot, and with due consideration to the peculiarities of the district, and even the particular farm where it is imparted, is no doubt of the greatest possible practical value, and is much better than instruction given at a dairy school at a distance, where the apparatus and fittings will be likely to err on the side of being too perfect. Professor Carroll, of Glasnevin, Dublin, himself assured me that the too elaborate nature of the dairies and fittings at model dairies had proved a hindrance rather than a help.

The Lower Agricultural Education (the Bailiff and Labourer).

Under this heading we have to consider the case of the labourer, including the bailiff, because the best bailiff is the labourer of extra intelligence who, by his ability and force of character, rises into the position of a bailiff. Good men of this class are very scarce indeed, and any suggestion which would tend towards the increase of their numbers will be welcome. The adoption of a system of general education throughout the country, such as is now happily in existence, will doubtless bear fruit in this direction, and it is a great question whether any better course can be recommended than that of sound education in the "three R's," followed up by years of practice in all the details of farm work. I would further suggest that the principles upon which agricultural practices are based should be taught in all rural schools, instead of far-fetched information upon subjects entirely beyond the *entourage* of the pupils.

The following is a quotation from a paper by Professor Fream, read before the British Association last September, upon preventible losses in agriculture:—

"The village school affords an admirable means whereby much useful instruction might be imparted to country lads, to their immediate intellectual benefit and to their subsequent welfare. For instance, attractive object-lessons in botany and entomology might be made the means of familiarising boys with the habits and life histories of farm pests, and would foster in them the practice of independent observation, so that in years to come for each pair of eyes now at work there might be thousands. It surely would not be difficult to interest an intelligent village boy in the natural history of wire-worms and leather-jackets, of turnip 'flies' and sawflies, of birds and insects which help the farmer, and of those which injure him, of the good grasses and the bad, and of notorious weeds and parasites. Yet, whilst the school wall is adorned with pictures of the tiger and the elephant of the Indian jungle, there are none showing the metamorphosis of a click beetle, or the structure of a grass. The boy may be taught to draw a map of the unstable frontiers of the south-east of Europe, which are hundreds of miles away, but he is never taught to seek out the ergot which infests the grasses, or to destroy the chrysalids which hang upon the hedgerows, or to recognise the plants of the meadow close to his cottage door. Knowledge such as this might become of much use to him, and render him a valuable and desirable farm-servant in after years; but it is kept from him, and he grows up stolid and indolent, because during the most impressionable years of his life our system of education fails to interest and instruct him in matters which will be of the greatest practical importance to him, and most intimately associated with his future labours."

My own experience is, that progress is checked by the stolid opposition of labourers to the introduction of anything out of their usual beat, whether in the employment of new implements, the introducing new methods of feeding animals, improved processes in hay-making, and in many other ways. Good practical instruction at the village school might, perhaps, encourage a more enlightened state of mind upon these subjects.

General Conclusions as to State-aided Agricultural Education.

Summarising the results of experience gained in various countries, it is evident that any attempt on the part of the State to create a demand for technical instruction on the part of farmers, has met with very partial success. Neither must we forget that all the State-aided agricultural schools form a part of a system of protection and artificial fostering of industries.

Finally, I protest against the founding of State-aided agricultural colleges, for reasons given in the earlier sections of this paper. I protest against hunters for

place and for pay. I claim some credit for Cirencester, for Downton, for Aspatria, Hollesley Bay, Hole-park, and for all other independent efforts to meet the very languid demand which no doubts exists for sound agricultural information. Let the subject be ventilated, and let the ideas spread through this wealthy, intelligent, free, and unfettered country. Nay, further, if a Government grant is to be given, let it aid existing efforts without greatly controlling them. Let it follow out the instructions given to Sir Richard Paget's Commission, namely, to "inquire and report upon agricultural and dairy schools in Great Britain which may properly receive Government grants." Let scholarships be given, that young men of talent may take advantage of existing means in instruction, or of those means of instruction which are speedily arising, and will continue to arise, if not throttled by an overshadowing State-aided system, fettered by officialism, and a prey to place hunters. Neither let us too hastily conclude that agriculture requires such aid. The cloud is lifting. Although we have passed through times of extreme pressure, we seem at last to have touched bottom, and the man who thinks of investing money in land, or in farming, can do so at the present moment with a better expectation of commercial success than he could have entertained at any time during the last twelve years. I do not deny that agricultural education has had much to do with this happy result; but it is not solely the education of the young nor the instruction of the professor or schoolmaster. It is the education which comes from conflict, the education which comes through the printing press, the instruction which flows from our agricultural literature and agricultural exhibitions; and I devoutly hope that this free course of knowledge and of enterprise will continue to be allowed to flow on without State patronage, and in harmony with the independent and courageous instincts of the British nation.

WAVE-POWER MOTOR.—The *San Francisco Call* gives an account of a new wave-power motor. The construction of this machine or apparatus was begun in July, 1886. Great difficulty was experienced at first in getting the materials to withstand the force of stones thrown against them by the waves, and the pipes which conduct the water up the bluff were broken and carried away no less than fourteen times. The motor, which was designed and built by E. T. Steen, is a very simple contrivance, and still is capable of exerting great power. Across a chasm in the rocks just north of Parallel Point, a bridge of heavy timbers was built. Suspended from this is a huge fan or paddle of oak timbers with the spreading portions downwards. This is fastened to the bridge by immense hinges, which allow it, when in operation, to swing back and forward a distance of 6 feet as the waves strike it. The handle or upper portion of the fan is connected with a solid plunger pump 12 inches in diameter, and having a stroke of 9 feet to 12 feet. This pump, in turn, is connected with a suction pipe running out into deep water. When a wave comes in, the fan is thrown forward and forces the air out of the pump barrel in which the plunger works. On the wave receding, the fan is carried seaward and the plunger drawn out, causing a vacuum, and causes a quick rush of water into the suction pipe. The force with which the water is drawn up is sufficient to raise it to an elevation of 350 feet above the sea level. This motor is capable of raising 12,000 feet of water 350 feet high in every twenty-four hours. The uses to which the water will be put are various. A 36-inch pipe will be conducted to the city, and water will be supplied to all branches of industry where machinery is used. Bathing-houses will also be supplied with salt water, and sewers flushed where it is necessary.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

ENEMIES OF TREES.

SIR,—I enclose £1 for 1888 as a contribution to the Egyptian Exploration Fund. I should be much obliged if you could get the writer of the article "Enemies of Trees," in the last number of SCIENTIFIC NEWS, to examine the enclosed tips of fir branches. Thousands of these fell in the autumn, and again now when the wind is high, but I scarcely think it is only the wind. They fall from old and young trees alike. There are squirrels here, but not many and not enough to do the amount of work, and they could hardly get to the ends of the branches. The ground is covered with them, and I shall be very pleased to have a satisfactory explanation. The men here say it is the wind. WILLIAM LANCE.

[Specimens of the fallen tips of fir will be forwarded to anyone interested in the subject.—EDITOR *S. N.*]

RABBITS ATTACKING A CAT.

On reading page 372 of SCIENIFIC NEWS for April 20th, I saw that in Australia domestic cats have been used as rabbi destroyers. I will mention an incident in which rabbits seemed as if they would have been cat destroyers. Among other pets, I had two black buck rabbits, a large tom-cat, and a skye-terrier. One day the rabbits got loose, and they, seeing the unhappy cat, immediately began to attack it. The cat, although a first-class ratter (like the dog), was terribly frightened, and never attempted to defend itself. The rabbits had gone so far as to bite a piece of the cat's ear before I had time to stop them. The rabbits, strange to relate, were on excellent terms with the skye-terrier dog. S. E. DUNKIN.

CRIES UTTERED BY FROGS.

In one of your recent numbers there was an interesting account of some barking frogs, which recalled to me a curious experience of last summer. I was talking to my gardener at Malvern, standing by the side of an asparagus bed, and watching the gambols of a very playful pet cat, who ever and anon disappeared down one of the overshadowed little trenches of the bed.

Presently I heard a loud, unfamiliar cry, as of pain or alarm, proceed from the midst of the tangled asparagus, and, with the gardener's aid, I began carefully to search up and down the tiny green glades—puss darting in and out as if sharing our investigation. To my surprise, I found the source of her excited enjoyment to be a large yellow frog, whom she had tormented to such an extremity that it had uttered this cry of anguish in its distress.

My gardener, a very intelligent and observing man, informed me that more than once before he had heard a similar cry from a frog in distress.

I send you this, thinking it might be of some interest to your readers. L. H.

Malvern.

CUNNING OF THE FOX.

The anecdote on page 348 of SCIENTIFIC NEWS was very interesting. Perhaps the following one, which I recently noticed in a book of natural history, may prove the same to some of your readers:—

"A tame fox, that was kept in a stable-yard, had managed to strike up a friendship with several of the dogs, and would play with them, but could not induce the cats to approach him. Cats are very sensitive in their nostrils, and could not endure the vulpine odour. They would not even walk upon any spot where the fox had been standing, and kept as far aloof as possible from him. The crafty animal soon perceived that the cats would not come near him, and made use of his knowledge to cheat them of their breakfast. As soon as the

servant poured out the cat's allowance of milk, the fox would run to the spot and walk about the saucer, well knowing that none of the rightful owners would approach the defiled locality. Day after day the cats lost their milk until the stratagem was discovered, and the milk was placed in a spot where it could not be reached by the fox. He was also very successful in cheating the dogs of their food, achieving his thefts by the force of superior intellect." F. P. P.

A UNIVERSAL DAY.

The adoption of a universal day, as described in your last number, would do away with a difficulty which, I believe, puzzles many persons besides myself. I have never yet seen a clear answer to the question, "Where, under the present arrangement, does the day begin?" For instance, I am writing on the 24th of April, at noon. This particular date at the meridian of Greenwich commenced twelve hours ago. At Berlin and Vienna it commenced something like thirteen hours since, and so the further East one travels the longer is it since this particular date commenced, until one comes to the meridian 180° East of Greenwich, where it must be exactly twelve o'clock *midnight* of the *same* date. At one minute past twelve noon, Greenwich time, it will be one minute past twelve past midnight—that is in the morning—at 180° East longitude. If to-day began at 180° East longitude from Greenwich, it must end 180° West longitude of Greenwich. The places just East of that meridian are therefore only finishing the 24th of April, while, say New Zealand, is just beginning the 25th. Here I am nonplussed. As a matter of fact, I should like to know whether there are places in the Pacific where the dates thus differ by twenty-four hours. If so, are these places known? For example, are there places not far apart which if they published evening newspapers to-day, would in the one case date those papers the 24th, and in the other the 25th? If so, where does the dividing line run? THOMAS C. DARE.

"THE SHELL-COLLECTOR'S HANDBOOK FOR THE FIELD."

In mere justification of my publishers and myself I may be allowed, in equal fairness with your reviewer, to reply to some criticisms made by him on the above manual in these columns some three or four weeks back. I would point out to him, in the first place, that as conchology is essentially a field, and not a home, study, the title is not a misnomer, and that had biographical descriptions of the various species been included in the text it would have made the book an exceedingly expensive one, and would altogether do away with the purpose for which it was written, viz., simply as an identification manual within the reach of the pockets of all. In the second place I would refer him to the latter portion of the preface, where he will find it stated that "the varieties described include those which have been verified by the Council of the Conchological Society or by myself," and these have been sifted from the garbage made by those tyro variety mongerers who do not yet understand the distinctions that can be legitimately drawn between type-forms and varieties, and who have had their futilities so well exposed by Mr. Woodward in the *Zoologist*, and by Mr. J. W. Taylor, in his recent Valedictory address, as President to the Conchological Society. It is to these spurious varieties that your reviewer, when he talks of "errors and omissions" evidently refers, but I may tell him that had I recognised them I had done wrongly to myself, and had deserved the greatest amount of censure that could be heaped upon me by all true and scientific conchologists. To me *Arion ater* v. *plumbea* is but a pale, and perhaps, a young, type, and not distinct enough in colour to warrant a varietal name. While *Limax arborum* was not named in my handbook as *Lehmannia marginata*, simply because the priority of the name has not yet been recognised by the Conchological Society. The scoop was not mentioned since it is, as yet, but new-fangled, and has not not stood the test of time as the water-net and walking-stick, which the majority of us take when out on a collecting excursion. J. W. WILLIAMS, M.A. D.Sc.

WHAT KIND OF LEVER IS AN OAR?

The occasion for this question, which is raised in a letter in SCIENTIFIC NEWS for March 2nd, arises from the circumstance that the power applied (the man rowing), and the support for the oar in the rowlock, are *both moved* by the act of rowing; but the lever action of the oar can be conveniently considered by substituting for the man a rope passing over a *stationary* pulley upon shore, having a weight hung to it equal to the pull of the man upon the oar. Taking the lengths of the oar inside and outside the boat to be in the proportion of 1 to 3 as in the above letter, and taking 3 ft. as the distance the boat is propelled by each stroke of the oar, and 4 lbs. as the resistance of the boat to the oar, then the work done at each stroke is 12 ft. lbs. (4 lbs. × 3 ft.). Then, taking first the case of the outer end of the oar being held stationary by the water without any back slip, the inner end of the oar will be moved 4 ft. in the stroke, as the rowlock of the boat is moved 3 ft., and consequently the weight pulling the end of the rope will descend 4 ft. in the stroke, and the amount of weight required is 3 lbs. to the work of 12 ft. lbs. (3 lbs. × 4 ft.). Now transfer the pulling from the shore to the bow of the boat, so as to represent the action of the man rowing, and the pulley will then be itself moved forward 3 ft. with the boat during the stroke, and the rope will consequently only pass over the pulley a distance of 1 ft. (4 ft. − 3 ft.), and the weights will only descend 1 ft.; the amount of weight required pulling the end of the rope is then 12 lbs. to do the work of 12 ft. lbs. (12 lbs. × 1 ft.). The pull exerted by the man rowing is therefore 12 lbs. to overcome a resistance of 4 lbs. in the boat, being a proportion of 3 to 1, the same as the proportion of the lengths of the oar outside and inside the boat; and the oar is in effect a lever of the first order, having its fulcrum at the rowlock.

In the case of the water yielding to the oar-blade, the outer end of the oar will slip back a certain distance during the stroke, instead of being held stationary by the water, and the boat will consequently not be propelled the full 3 ft. at each stroke, some of the power employed being expended upon displacement of the water by the oar-blade.

W.

ANSWERS TO CORRESPONDENTS.

H. R. COLES.—We believe that Colatina can be obtained of Messrs. Christy and Co., 155, Fenchurch-street.

A. G. TINDALL.—The only way to carry out the experiment you wish to perform would be to look through a solution of quinine at the ultra-violet part of the spectrum. We do not know of any such ink.

GEORGE WHITFIELD.—We can see no proof and believe that this method is only approximately correct. Try it on a very large scale.

RACIAL ELEMENTS OF THE RUSSIAN ARMY.—Probably the Russian army is the most heterogeneous in the world so far as its ethnology is concerned. From the information on the point just issued by the Russian Statistical Department we learn that of the 227,906 recruits levied in 1885, the racial composition was as follows:—Russians, 169,052; Poles, 17,212; Bulgarians, 406; Tchecks, 12; Lithuanians, 5,800; Letts, 3,424; Greeks, 155; Moldavians, 2,350; French, 1; Germans, 3,572; Armenians, 142; Bohemians, 39; Georgians, 3; Jews, 10,011; Karehans, 309; Tchouds, 20; Esthonians, 2,604; Laps, 1; Moravians, 1,707; Cheremissians, 704; Votiaks, 841; Zyrians, 282; Permians, 68; Voguls, 5; Chuvachis, 1,529; Tartars, 4,508; Bashkirs, 3,017; and about 100 belonging to three other races or tribes. In all, then, the Russian army comprises 32 different race, or at least tribal, elements, among which it is noteworthy neither Ossetians nor Circassians are represented, so far at least as these recruits are concerned.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

REMOVING PAINT.—A paste for removing paint has been patented by M. Benedictus, Belgium. It is composed of the following ingredients:—Water, 23 parts; meal or flour, 4; borax or alum, 1; black soap, 4; and mixed caustic soda and potash, 11.

TOBACCO PIPE.—Mr. J. Bennett has patented a tobacco pipe. A cylinder, with a helical groove formed therein, is inserted in the stem of the pipe. The cylinder may be surrounded by an absorptive tube of paper pulp. The helical groove may be replaced by a number of circular grooves, communicating by channels.

POLISHING POWDER.—Mr. R. Hutchinson has patented a polishing powder. It is made of the following ingredients well mixed together. 112 lbs. of purified chalk, well washed and dried, 7 lbs. carbonate of lime, 3½ lbs. phosphate of lime, 3½ lbs. bone ash, 2 lbs. rouge, 1 pint of methylated spirits, ¼ ⅝lb. liquid ammonia, 2 ozs. of soda, ¼ oz. of carmine.

LIFE BUOY.—Mr. D. J. H. Davis, Plymouth, has patented a life-buoy. To a buoyant ring of cork or metal tubing a bridle is pivoted, which, when the buoy hangs in place, lies in a plane with the ring, but, when it is in the water, stands vertical. One end is weighted, and the other carries a flag and tube containing a signal light for use during day and night respectively. Across the ring is a seat of rope or metal, and to it are lashed life lines as usual.

PRESERVING PLANTS.—A process for preserving plants has been patented by Mr. T. Reinherz, Bavaria. The plant is first treated with alcohol in order to remove the water it contains, so as to facilitate the adhesion of the coating. The plant is then put into an air bath at 80° C. to drive off the alcohol. The preserving fluid is then brushed on at a temperature which is preferably lower the more tender the leaves, green plants being treated at a temperature approaching boiling point.

ELECTRIC LAMPS.—An incandescent electric lamp has been patented by Mr. C. Seel, Berlin. Several filaments contained in one bulb terminate at one end in separate contact pieces etc., and are united at the other end by a thickened centre-piece of comparatively low resistance. Two or more of the filaments may be used at one time, the illuminating power of the lamp being thus varied or the life of the lamp may be lengthened by using the filaments in succession. The filaments may be made separately and afterwards cemented together, or the multiple filament may be made in one piece. The wires connecting the filament terminals with the contact screws pass through a tube provided with air holes.

ROAD SWEEPER.—Messrs. W. T. Carter and J. Keeble, Bury-St.-Edmunds, have patented a road-sweeping machine. The machine is for attachment behind an ordinary cart, and consists of an endless chain of brushes, which sweep the refuse up an inclined box into the cart as it is drawn along. The bottom of the box is curved to allow for the "sag" or drooping of the chain, and is fitted with an adjustable end which may have an india-rubber strip at the bottom. The lower chain wheel is driven by the machine road wheels through spur gearing. The chain wheel axle bearings are adjustable along suitable slots by screws. The draw bar from the cart is secured to a link over the front central steering wheel.

TONOMETER.—An apparatus for assisting in tuning musical instruments has been patented by Mr. A. Allam Leverton-street, Kentish Town. The apparatus is in the form of a flat oblong box, circular at one end. A wheel is fixed at this end, in a horizontal position, so as to revolve freely; a wire is passed around the wheel and fixed parallel and at equal lengths at the other end. One portion of the wire is then tuned to a convenient note, and, the pressure being equal on both sides, brings both portions of the wire into perfect unison. A bridge at each end, running at an angle of 45° across the apparatus, reduces one portion of the wire by half, the reduced portion of the wire, being exactly half the length of the longer portion, will give the same note, but an octave higher. By striking the two portions of the wire at the same time, the unison of the octave is produced.

PARLOUR FOOTBALL.—Mr. C. B. Suffield has patented a parlour football game. A board has its centre portion divided into equal spaces numbered 0 to 24 on the dividing lines, commencing with 0 in the centre, the 25th space at each end being marked as a goal; every fifth space represents a scoring point in the game. The game may be played by two or several players. The football, made of leather and very small, is placed upon the line marked 0, a player then casts the dice, and whatever number is thrown the player moves the ball a corresponding number of lines towards his goal. A player on the other side then throws the dice and moves the ball back towards the opposite goal. Whenever the balls falls upon any of the scoring lines, the player either obtains a benefit or reverse, according to the rules laid down.

AIR TESTER.—An automatic air tester has been patented by P. Pfleiderer, on behalf of Dr. A Wolpert, Germany. This invention consists of an apparatus for indirectly testing the purity of air in which the amount of carbonic acid gas present is actually estimated, the estimate being used as an indicator of the purity of the air. A glass vessel is filled with an akaline solution, coloured with phenol-phthalein or other suitable indicator, and protected from the action of the air by a thin layer of mineral oil, and a float, to which is attached a fine syphon, arranged so as to deliver one drop every 100 seconds, is placed therein. The coloured drops fall into a funnel, and from thence down a tape, string, etc., to a receptacle, being bleached sooner or later by the carbonic acid in the air. An empirical scale, attached to the glass vessel, is also provided, so that if the coloured liquid is bleached, say opposite the top division of the scale, the air would be pronounced "extremely bad," while if it reached down to the bottom division of the scale, before losing its colour, the air would be "very pure."

ANNOUNCEMENTS.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER. — The spring session of this college concluded on April 18th, when the Principal, the Rev. J. B. M'Clellan, distributed the diplomas, etc., in the college hall. Excellent reports of the work of the term were given by the Principal and Professors M'Cracken (agriculture), Kisch (chemistry), Anderson (estate management), Ohm (physics), Paton (book-keeping, engineering, and surveying), Harker (natural history), Almond (veterinary surgery), and Barfield (drawing). Mr. Goddard obtained the highest number of marks on record at the Royal Agricultural College. The external examiners for the diploma were, in practical agriculture, Mr. Thomas Lathom, of Abingdon, Berks, and Mr. Thomas Nuttall, of Beeby Manor, Leicester; and in agricultural chemistry, Dr. J. Voelcker, London. The diploma of membership was gained by Alexander Goddard, Knighton Spinneys-Leicester, and A. Turner Bellingham, Gwydir-gardens, Swan sea. The Ducie gold medal fell to A. Goddard, and the scholarships to Montague Kelway Bamber, Altons, Rusper, Sussex, and James Muir, jun., Staunton Harold, Branksome-park, Bournemouth (equal); and to George German, Huntingdon House, Ashby-de-la-Zouch, John Norman Heathcote, 44, Seymour-street, London, W., and Syad Mohammad Hadi, Oude, India (equal).

ROYAL GEOGRAPHICAL SOCIETY.—At the meeting of the council of this Society, held on April 23rd, the awards for the year were settled. The Founders' medal has been given to Mr. Clement R. Markham, C.B., F.R.S., on his retirement from the honorary secretaryship of the Society, after twenty-five years' service, and in acknowledgment of the valuable services rendered by him to the Society during that period. Every one connected with the Society and every one interested in the progress of geography will learn of Mr. Markham's resignation of his office with real regret. It is impossible to over-estimate the value of Mr. Markham's services to the Royal Geographical Society and to geography generally in this country. As Mr. Markham is still vigorous and energetic, there is no reason why these services should not be continued. The medal is awarded also for his numerous and important contributions to geographical literature during the last thirty-five years, and in recognition of his merits as an active explorer in the Eastern Andes in 1853; and again in 1860, when he was engaged in relation to the propagation of cinchona trees; and in Abyssinia in 1866-7, when acting as geographer to the expedition in that country. The eminent services rendered by Mr. Markham to the Hakluyt Society should also not be forgotten. The Royal medal has been awarded to the German explorer, Lieutenant Wissmann, in recognition of his great achievements as an explorer in Central Africa, which he has twice crossed from the Atlantic to the Indian Ocean, and especially for the arduous and adventurous journey in which he traced the course of the river Kassai, from its upper waters to its previously unknown confluence with the Congo. The Murchison grant has been awarded to Mr James M'Carthy, Superintendent of Surveys in Siam, for his excellent map of Siam, and the great value of his survey work generally in that country. The Gill premium is awarded to Mr. Charles M. Doughty, whose great work in Arabia was noticed in *The Times* the other day. The Accumulated Cuthbert Peak grant is given to Major Festing for his services as cartographer on the Gambia river and the country in the neighbourhood of Sierra Leone. As Honorary Corresponding Members have been selected Dr. G. Radde, of Tiflis; Dr. H. Rink, of Copenhagen; and Dr. Rein, Professor of Geography at Bonn.

THE SOCIETY OF ANTIQUARIES OF LONDON.—At the meeting on April 23rd the following gentlemen were elected as officers and council for the ensuing year:—President, John Evans, Esq., LL.D., D.C.L., F.R.S.; Vice-Presidents, Augustus Wollaston Franks, Esq., M.A., F.R.S., Charles Drury Edward Fortnum, Esq., D.L., J.P., James Ludovic Lindsay, Earl of Crawford and Balcarres, LL.D., F.R.S.; Treasurer, Charles Spencer Perceval, Esq., LL.D.; Council, Henry Sainsbury Milman, Esq., M.A. (Director), the Hon. Harold Dillon (Secretary), Edward William Brabrook, Esq., James Hilton, Esq., Frederick George Hilton Price, Esq., Henry Reeve, Esq., C.B., D.C.L., Somers Clarke, Esq., the Very Rev. Arthur Perceval Purey Cust, D.D., Dean of York, Edwin Freshfield, Esq., LL.D., D.L., Professor Percy Gardner, D.Litt., William John Hardy, Esq., Stanley Leighton, Esq., M.A., M.P., Charles Trice Martin, Esq., B.A., Henry George Early Percy, Lieut.-Gen. Augustus Henry Lane Fox Pitt Rivers, F.R.S., Edward Maunde Thompson, Esq.

THE ROYAL SOCIETY.—The following fifteen candidates were selected yesterday by the Council of the Royal Society to be recommended for election into the Society. The ballot will take place on the 7th of June at 4 p.m.—Mr. T. Andrews, Mr. J. T. Bottomley, Mr. C. V. Boys, Professor A. H. Church, Professor A. G. Greenhill, Sir W. F. D. Jervois. Professor C. Lapworth, Professor T. J. Parker, Professor J. H. Poynting, Professor W. Ramsay, Mr. T. P. Teale, Mr. W. Topley, Mr. H. Trimen, Professor H. M. Ward, and Mr. W. H. White.

ROYAL COMMISSION ON UNIVERSITY EDUCATION IN LONDON.—The *British Medical Journal* understands that Lord Selborne, who, as Sir Roundell Palmer, was for many years one of the standing Council for the Royal College of Physicians will be Chairman of this commission. The commission will consist of seven members, and will not include any member of the medical profession.

DIARY FOR NEXT WEEK.

Monday, May 7.—Aristotelian Society Symposium, at 8 p.m.—*What is the Distinction between Desire and Will?* Professor Bain, Mr. W. R. Sorley, Mr. J. S. Man.

Bradford Naturalists' Society, at 7.30 p.m.—*Fossil Mollusca;* Mr. J. A. Hargreaves.

Victoria Institute, at 8 p.m.—*The Names on the List of Thothmes III. assignable to Judæa;* Professor M. Maspero.

Royal Institution, at 5 p.m.—*General Monthly Meeting.*

Society of Engineers, at 7.30 p.m.—*Filtration by Machinery;* by Mr. Edward Perrett.

Society of Chemical Industry.—*Standard of Light;* by Mr. W. J. Dibdin.

Society of Arts, Cantor Lecture, at 8 p.m.—*Decoration;* by Mr. G. Aitchison.

Tuesday, May 8.—Royal Colonial Institute, at 8 p.m.—*The New Industrial Era in India;* by Sir William Wilson Hunter, LL.D.

Royal Institution, at 3 p.m.—*The Plant in the War of Nature;* by Mr. W. Gardiner.

Parkes Museum, at 8 p.m. — *General Powers and Duties of Inspector of Nuisances, Method of Inspection;* by Mr. J. F. J. Sykes, B.Sc., (Pub. Health) M.B.

Society of Arts (Applied Art Section) at 7 p.m.—*The Decorative Use of Colour;* by Mr. J. D. Crace.

The Institution of Civil Engineers, at 8 p.m. — *The Distribution of Hydraulic Power in London;* by Mr. E. B. Ellington, M. Inst. C.E. *The Tay Viaduct, Dundee;* by Mr. Crawford Barlow, M. Inst. C.E. *The Construction of the Tay Viaduct, Dundee;* by Mr. W. Inglis, Assoc. M. Inst. C.E.

Wednesday, May 9.—Iron and Steel Institute, at 10.30 a.m.—*On the Mutual Action of Sulphur and Silicon in Iron at High Temperatures;* by Mr. T. Turner, Mason College, Birmingham. *On the Use of Water Gas for Metallurgical Purposes;* by Mr. A. Wilson, Stafford. *On an imperfection in Mild Steel Plates considered Chemically;* by Mr. H.

Eccles, Port Talbot. *On the Mechanical Apparatus for Continuous Moulding at the Works of M. Godin, Guise* ; by Mr. Jas. Johnston, Manchester. *On the Effect of Arsenic on Mild Steel;* by Mr. F. W. Harbord, and Mr. A. E. Tucker, Bilston. *On the Manufacture of Ordnance at Trubia;* by Major Cubilio, Trubia.

Civil and Mechanical Engineers' Society, at 7 p.m.— *General Meeting.*

Society of Arts, at 7 p.m.—*Locks and Safes ;* by Mr. Samuel Chatwood.

Royal Microscopical Society, at 8 p.m.—*New Infusoria Flagellata from American Fresh-Waters ;* by Dr. A. C. Stokes.

Thursday, May 10.—Iron and Steel Institute, at 10.30 a.m.—*On the Melting of Wrought Iron or Steel Scrap mixed with Ferro-Silicon in Cupola Furnaces ;* by M. F. Gautier, Paris. *On the Behaviour of Arsenic in Ores and Metals during Smelting and Purification Processes ;* by Mr. John Pattinson, Newcastle-on-Tyne, and Mr. J. E. Stead, Middlesbrough. *On a New Instrument for the Measurement of Colour, more especially as applied to the Estimation of Carbon in Steel ;* by Mr. H. Le Neve Foster, West Hartlepool.

London Mathematical Society, at 8 p.m.—*Some Theorems on Parallel Straight Lines, together with some Attempts to Prove Euclid's Twelfth Axiom ;* by Mr. J. Cook Wilson. *On Cyclicants or Ternary Reciprocants and Allied Functions ;* by Mr. E. B. Elliott. *On the Correlation of Two Spaces each of Three Dimensions ;* by Dr. Hurst, F.R.S.

Royal Institution, at 3 p.m.—*The Chemical Arts ;* by Professor Dewar, F.R.S.

Society of Telegraph Engineers and Electricians, at 8 p.m.—*On the Risks of Fire Incidental to Electric Lighting ;* by Mr. W. H. Preece, F.R.S.

Friday, May 11.—Royal Institution, at 9 p.m.—*Some Curious Properties of Metals and Alloys ;* by Professor Chandler Roberts Austen, F.R.S.

Farkes Museum, at 8 p.m.—*Nature of Nuisances, including Nuisances the Abatement of which is Difficult ;* by Mr. J. F. J. Sykes, B.Sc. (Pub. Health) M.B.

Balloon Society of Great Britain, at 8 p.m. —*Fire Prevention* ; by Mr. E. C. Marriott.

Royal United Service Institution, at 3 p.m. —*The Formation of Volunteer Field Batteries for Home Defence ;* by Captain Francis G. Stone, R.A.

Saturday, May 12.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner ;* by Mr. C. Ambruster.

Physical Society, at 3 p.m.—*Note on the Condition of Self-excitement in a Dynamo Machine, and Note on the Conditions of Self-Regulation in a constant Potential Dynamo Machine ;* by Professor S. P. Thompson. *Note on the Electrical Action of Light ;* by W. E. Ayrton. *On the Theory and Practice of Applying the Dynamometer to the Investigation of Transformers ;* by Mr. T. H. Blakesley. *On Measuring the Electro-Motion Force of Dynamos and Motors ;* by Professor W. E. Ayrton, F.R.S., and Professor J. Perry, F.R.S.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

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Dynamo, 60-candles, improved armature, 45s. ; photo. 5 stamps. Castings, lamps, etc. ; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s. ; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

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Fretwork, Carving, Turning, Woods, Tools, and all requisites. Catalogue with 700 illustrations, 6 stamps.—HARGER, BROS., Settle.

Second-hand Lathes, and other tools, offered cheap ; on view, Britannia Co., 100, Houndsditch, London.—Send 2 stamps for list, to Britannia Works, Colchester.

"Inventors' and Manufacturers' Patent and Trade Mark Pocket Guide," by G. C. MARKS, C.E., 13, Temple Street, Birmingham. Four stamps.

"Sheet Metal Worker's Instructor," Warn's ; few copies, cheap, covers slightly soiled.—94, St. Augustine's Road, N.W.

Minerals, Fossils (Carboniferous, Lias), 12 specimens, 2s. 6d. ; polished specimens, 6d. to 9d.—C. WARDINGLEY, Blackwood Crescent, Edinburgh.

"Dynamo Construction for Amateurs and Engineers," illustrated pamphlet, post free, 1s.—ALFRED CROFTS, Electrician, Dover.

Cameras and Apparatus. Good workmanship ; low prices. Price list free.—J. BRAINE, 22, Bedford Terrace, Moray Road, Holloway.

Patterns: 100 Fretwork, 100 Repoussé, 200 Turning, 300 Stensils. 1s. each lot.—COLLINS, Summerlays Place, Bath.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

X, Electro-Plating and Gilding taught to perfection ; system inexpensive ; distance no object ; exchange for anything useful (stamp).—PERKS, 47, Alexandra Road, Richmond, Surrey.

SELECTED BOOKS.

Electric Light Arithmetic. By R. E. Day, M.A., Evening Lecturer in Experimental Physics at King's College, London : Macmillan and Co. Price 2s.

Tea Cultivation and Manufacture. By E. Money. Fourth edition. Whittingham. Price 10s. 6d.

Scientific News

FOR GENERAL READERS.

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CURRENT EVENTS.

DRAWING AS A MEANS OF EDUCATION.—Last week Mr. T. R. Ablett read a very interesting and suggestive paper on the above subject, at the Society of Arts. We are all familiar with the teaching of drawing for artistic purposes, but comparatively little attention has been given to the subject as a means of education. In some schools it is even classed with dancing and such like "extras." Drawing has been for the few rather than the many, and, as the lecturer pointed out, the methods of teachers are usually directed to pupils who have a natural aptitude for the work. As to the intrinsic value of drawing, it may be said to be the language of architects and engineers, and it is of great importance to military and naval men, to designers and scientific men, and many others. But apart from such persons who require drawing for technical or trade purposes, we have to consider its educational effect and the benefits it confers on all who learn it.

As Mr. Ablett remarked, too much must not be expected from the average pupil, and although many are wanting in manipulative power, they have intelligence and can learn to draw in a way useful to themselves, and this aids the development of their faculties. At the same time the teacher must be satisfied if the pupil works up to the limit of his or her capacity. No one, of course, should be careless, but manipulative excellence must not always be insisted upon. Children are by nature very observant, and drawing furnishes them with the most delightful mode of describing the things which interest them. A child's fondness for imitating produces in it a desire to make representations of things which are attractive or astonishing, long before its mind is sufficiently developed to enable it to cope seriously with reading, writing, arithmetic, and kindred subjects. We agree with the lecturer that this desire to draw should be fostered and encouraged.

Above all, it promotes accuracy in observation and thought, for when an attempt is made to sketch anything from memory a mental picture of the object must first be called up. Be the object ever so simple, its form must be noted before the sketch can be made, and after a little practice attention is habitually given not only to the form, but to the size in relation to surrounding objects. Later on even the details of construction are noticed and reproduced. The power to draw is not only a source of endless pleasure, and of very great use, but it is also an excellent mental exercise, provided it is taught in a rational and attractive manner.

THE COLLEGE OF STATE MEDICINE.—The introductory lecture of the inaugural session was delivered by Mr. Brudenell Carter, under the presidency of Sir Joseph Fayrer. The lecturer remarked that the function of a College of State Medicine should be—first, to enlarge the knowledge of members of the medical profession with regard to the causes and the prevention of disease; and, secondly, to instruct the public with regard to the value and importance of such knowledge. He added that the immediate future of preventive medicine seemed to lie in the pursuit of bacteriology, and it would be one of the chief objects of the College to provide practical teaching and opportunities for actual work in this highly specialised department of research. Another important branch of the professional teaching of the College would have reference to the investigation of the various conditions, special to particular trades, manufactures, or forms of industry, by which the health of those exposed to them was liable to be injuriously affected. Instruction would also be given in the analysis of food, water, and air, also in so much of the principles and details of sanitary house

construction as might be necessary for medical purposes. While such would be the functions of the College in relation to the education of practitioners, steps would also be taken to teach the public the immutability of the natural laws on which sanitary science depends, and the inevitable consequences which follow the violation of those laws. If no more is done than the breaking down of the generally prevailing ignorance and indifference on this all-important subject, no mean thing will have been accomplished.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

On page 394 of this magazine is an abstract of Adhémar's bold speculation concerning the alternate arctic and antarctic accumulation of an ice mountain 60 miles high from the sea bottom, undermined by the water, and resting on a huge pedestal. Besides the serious objections stated in the article referred to, there is another that is fatal to this and to all other assumptions of polar ice caps of great height and steepness. I refer to the fact that ice is sufficiently plastic or viscous to flow down any outlet that presents itself when urged by the pressure of a great superincumbent mass. As Forbes showed long ago, the glaciers of the Alps are thus produced. They are the outflow of the nevé or great ice fields above.

A grand example of this is presented by the Justedalsbrae in Norway, the largest mass of ice, *i.e.*, the largest nevé in Europe. It is a tableland piled up with snow, that has settled down into blue ice with an unbroken area of about 500 square miles. The central portions of this are somewhat higher than the boundaries, and, consequently, the pressure of the ice upon itself produces a creeping outflow in all directions, the mode of outflow varying with the ground. Generally, the boundary of the tableland has the usual form of long eroded grooves or notches, *i.e.*, ordinary steep valleys. All of these (so numerous that they have not been counted) are wholly or partially filled with down-flowing glaciers, similar to those of the Alps, some of them very fine. This is especially the case with those that flow into the magnificent valley which bears the general name of the Justedal.

But in some places the overflow takes a different form, viz., that of a veritable cascade of ice pouring over a precipice. This occurs when the table-land is bounded by a perpendicular wall of rock, *i.e.*, where the conditions are the same as those producing a cascade of water where the upland receives rain instead of snow.

In the course of my solitary pedestrian wanderings hereabouts in 1856, I came unexpectedly on a fine example of this. After climbing over a great tract of glacier *débris*, and glacier-planed rock, I reached the summit of the Handspiken field, a region then unknown to English tourists, and stood upon the shore of the head water of the Justedal river, worthily named *Styggevandet*, the hideous lake. The opposite shore was a gloomy precipice of dark rock in deep shade, fringed at the top with a blue crystal ridge through which the sun was shining. This was a portion of the N.E. boundary of the great ice field. Floating on the lake below were some small icebergs, the origin of which was revealed by further observation. Some parts of the upper blue fringe of the black precipice were perpendicular upward continuations of the rock itself, walls of clear ice. At other parts there were great bending sheets, or overhanging cornices of ice, extending for some distance downward over the face of the dark rock, and with great icicles fringing the lower part of the cornice. Here and there were crevices just above the edge of the rock where the bending was the sharpest. It was evident that these were overflowing downpours from the great ice region above, and although none came down while I was there, it was also evident that the weight of the down-hanging masses must presently exceed the tenacity of the ice at the edge of the rock, and then they must break off just there where the cracks were threatening; thus leaving an ice-wall at the place of fracture, and supplying another little iceberg to float on the lake.

Such bending over and gradual breaking off would follow any undermining of any great ice-wall, and prevent any such catastrophe as Adhémar describes. His sixty-mile heap of polar ice, or even the twenty-four-mile heap of Croll would be impossible with a steep slope. The summit pressure would bulge out the boundaries, giving the whole ice-cap the oblate speroidal shape of a batch-cake formed by a lump of dough left to its own gravitating resources on the hot plate of an oven, and this would go on subsiding and outspreading, to form an ice sheet rather than an ice mountain.

The plasticity of ice is well illustrated by an experiment I devised some years ago. I had a strong iron syringe, the piston of which was actuated by a screw. Pieces of ice about half an inch across were placed in the cylinder. On screwing down the piston the ice was squirted into long sticks about one-twentieth of an inch in diameter. A similar experiment has been made by filling a bombshell with water and exposing it to a freezing temperature. A crust of ice is first formed all round the inner surface of the shell, then, as the expansion due to the freezing of the inner water proceeds some of this ice is wedged outwards and forms a stick of ice protruding from the fuse hole. A similar experiment may be made by using a strong phial. Unless the phial breaks, a plug of ice will protrude from the neck. The smaller the neck the more striking the experiment. A champagne bottle may be used.

Our vegetarian friends are very earnest in advocating the use of whole-meal bread, and there is no doubt that the arguments they use in its favour have considerable force, but, as usually stated they involve a rather serious error. Whole meal, properly so called, includes all that is obtained by grinding wheat, *i.e.*, the flour, the pollard, and the bran. The bran is the outer husk or cuticle of the wheat, which is so tough and so woody in its structure (it consists, in fact, chiefly of cellulose or woody fibre) that ordinary millstones do not grind it; they merely peel it off the grain in the form of scales of considerable size. The following is Dr. Pavy's account of this husk, or "tegumentary portion" of the wheat. It "constitutes the greater bulk of the bran, and is of a perfectly indigestible nature, and therefore useless as an article of nutrition. Moreover, it acts, to some extent, as an irritant to the alimentary canal, and thus, whilst of service, retained with the flour, in cases where constipation exists, it should be avoided in irritable states of the bowels, and also by those who work hard, for with these it is likely to hurry the food too quickly through the alimentary tract, and occasion waste by promoting its escape without undergoing digestion and absorption." ("A Treatise on Food and Dietetics," p. 211.)

But besides this outer skin there is an inner cortex that is softer, more friable, and of very different composition. It contains a larger proportion of nitrogenous material and of the phosphates that have such high nutritive value in the sustenance of bone and brain than any other part of the grain. When ground it forms the thinner smaller scales known as the "pollard."

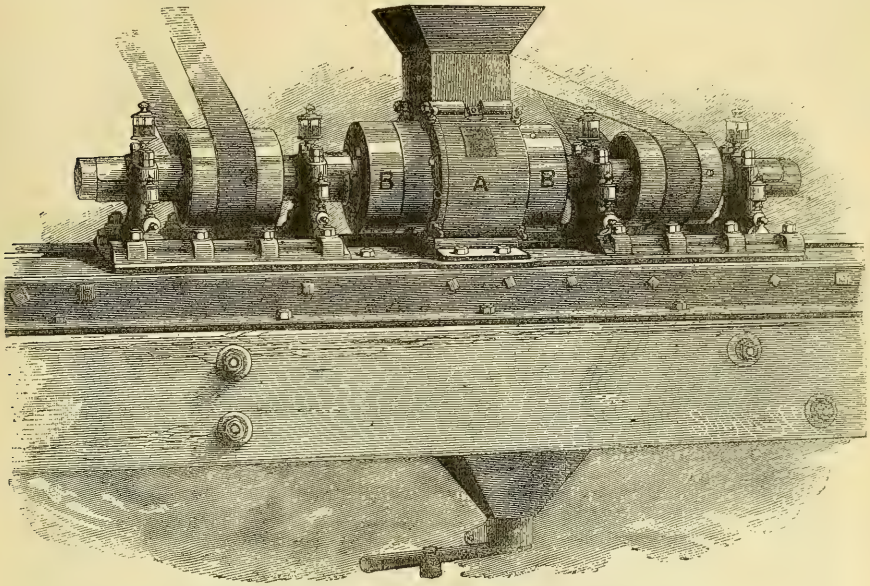

FIG. 1.—THE STURTEVANT MILL IN OPERATION. (*For description see next page.*)

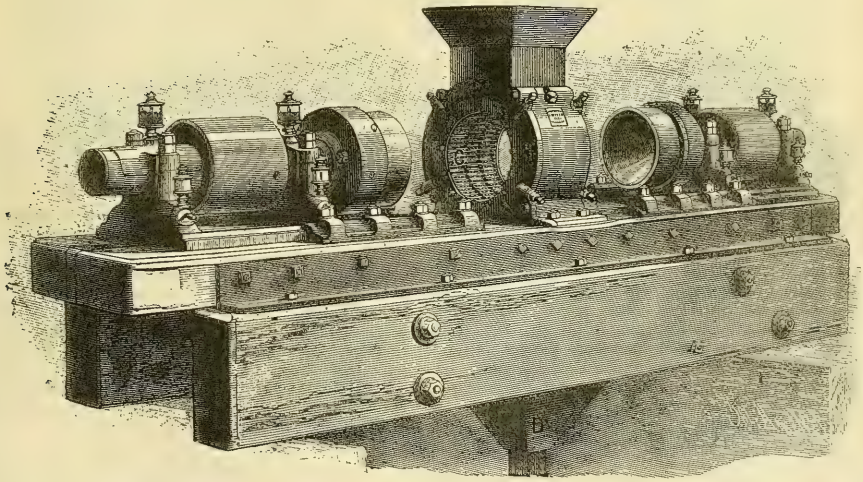

FIG. 2.—STURTEVANT MILL WITH CUPS DRAWN BACK.

My object in writing is to point out the difference between bran and pollard, and to suggest that a model bread should be made not exactly of whole-meal but of

meal from which the bran has been sifted while the pollard remains. Besides the above-stated constituents of pollard it contains a small quantity of *cerealine*, which, according to some good authorities, acts like the diastase of the saliva in converting starch into sugar. If this be correct, it not only adds to the nutritive value of the bread by its own direct contribution of nutritive material, but it also renders the other portion more nutritious by assisting its digestion. Such bread as I propose is of excellent flavour, but of rather dark colour.

THE STURTEVANT CRUSHING AND GRINDING MILL.

THE Sturtevant mill is an American invention used for crushing and grinding ores, cements, phosphates, emery, and such like hard substances. For work of this kind there are usually two operations; first, the crushing, then the grinding, and generally this is done in separate machines. In the Sturtevant mill the crushing and grinding are effected simultaneously in one machine of small dimensions and of very simple construction, and the speed with which it does its work, with very little wear and tear, is certainly remarkable.

Fig. 1 represents the mill in operation, the material to be ground being fed into the open hopper at the top of the casing A, and passing out when ground through the bin D. The driving pullies are on separate shafts, and on the end of each shaft is a hollow cup B, the edge of which just enters the side opening in the casing A. Fig. 2 represents the cups drawn back from the casing, and shows a circular grating or screen C inside the latter. Fig. 3 is a sectional view of the two cups, and of the interior of the mill when charged with material to be ground.

We are informed that with the smaller sizes of mills the two cups are sometimes driven in the same direction, and sometimes in opposite directions; but in the large sizes it is usual to drive them in the same direction and at the same speed. As the material passes through the mill it is crushed and pulverised, not by grinding against the surfaces of the machine, but by the force with which the pieces of rock, etc., are made to grind against each other. The speed varies from 900 to 1,800 revolutions a minute, according to the size of the machine, and at this high speed the grinding force is very considerable, and showers of sparks can be seen inside the mill. The rapidity with which the work is done can be best imagined when we say that we have seen, at the works of the Lawes Chemical Manure Company, at Barking, a mill twenty inches in diameter, crush and grind large pieces of phosphate rock from South Carolina, at the rate of about fifteen tons an hour—about 25 per cent. leaving the mill as fine powder, the remainder being coarse powder, mixed with pieces not larger than peas. Judging by the freedom of the shafts when running, the horizontal thrust on the cups appears to be slight, and a remarkable feature is that a very short time after the mill has been started a hard deposit of ground material is formed on the inside of the cups, and assumes a conical shape as shown at ZZ in Fig. 3. This deposit adheres tenaciously to the cups, and is so hard that it can only be removed with difficulty, and it protects the iron most effectively; in fact, the edges of the cups, and to a less extent the screen C, are the only parts of the inside of the mill which are liable to wear. The cups are made of chilled cast-iron, and when the edges are worn the shafts are moved a little nearer to the casing, the bearings of each shaft being fixed to a moveable base for this purpose.

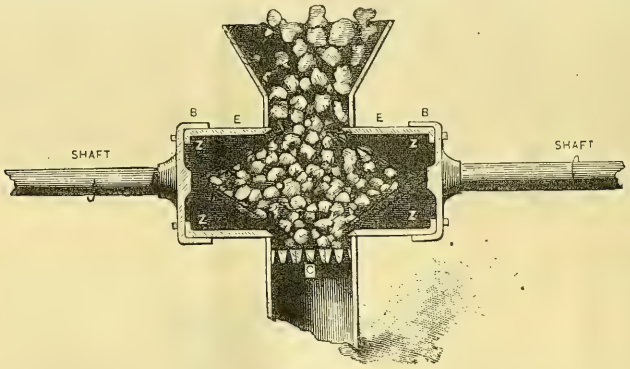

FIG. 3.—SECTIONAL VIEW OF INTERIOR OF MILL.

In connection with the mill there is a rotary fan which causes a strong current of air to be drawn downwards through the mill, and in this way it is kept cool, while at the same time all escape of dust is prevented. During the working of the 20-inch mill above referred to, although the interior was full of sparks caused by the violent contact of the pieces of rock, the casing A was cool, and the ground material which fell from the bin was only slightly warm.

The makers have a theory that each of the rotating cups sets up a centrifugal force, which hurls its contents against those of the opposing cup. Seeing, however, that the capacity of each cup is small, especially when the deposit Z has been formed—and that between the cups there is the mill itself, which is charged with material, as shown in Fig. 3—there is little probability that the pieces can be thrown about in the manner sug-

gested. It is more reasonable to suppose that, as the cups revolve rapidly, while the mill itself is stationary, the pieces of rock in the cups grind hard against the pieces in the centre of the mill. It should also be remembered that the pieces are in different positions and therefore travel at different velocities, and this, doubtless, promotes the friction to which the grinding is due. In confirmation of this view that there is a grinding action rather than a crushing or breaking caused by a collision of the pieces, we may add that the small pieces which pass out of the mill have a rounded appearance without sharp edges.

We offer these remarks in no controversial spirit, but merely with a view to the right understanding of the principles on which the action of the machine depends. It is cleverly devised, and is certainly deserving of attention.

We are not in a position to compare the working cost of this mill with that of its competitors, but we are informed by the representative of the Lawes Manure Co., that having thoroughly tried the Sturtevant mill, they have the highest opinion of it and greatly prefer it to several others they have tried. We also learn that Messrs. Langdale and Co. have used it for some months at their chemical manure works near Newcastle-on Tyne and are well pleased with it. The mill was first brought to England last autumn; but in the United States it has been much used during the past four years, and is very highly spoken of. Further particulars can be obtained on applying to the Secretary of the Sturtevant Mill Co., 2, Suffolk Lane, London, E.C.

LIGHTNING.

FAMILIAR to us as lightning is, we do not yet know how the electricity is generated which gives rise to the flash. Professor Tait says that it cannot, as far as laboratory experiments go, be produced either by the evaporation or by the condensation of water. Some authorities have assigned its production to the formation of hail, others to the molecular actions which accompany the diminution of total surface when two or more drops of water coalesce; while others ascribe it to the friction of moist against dry air, or to the dust particles in the air. The phenomenon has also been assigned to electricity due to the contact of uncondensed vapour with the particles of the air. The great difficulty in all these theories is, What becomes of the electricity equal and opposite to that in each drop, which must be produced simultaneously with it? So far as we are aware no answer has been given to this question of Professor Tait's.

There are several forms of lightning. In the first place there are well-defined ribbons or lines of light, moving in a more or less zig-zag path, such as those shown in our illustrations, which by the kind permission of the Meteorological Society are reproduced from photographs taken at Mount Vernon, New York, on July 12th, 1884, at 8 p.m., by Mr. G. R. Allerton. The exposure for fig. 1 was five minutes, and for fig. 2 two minutes, but unfortunately we do not know whether more than one flash was recorded on each plate.

Fig. 1.

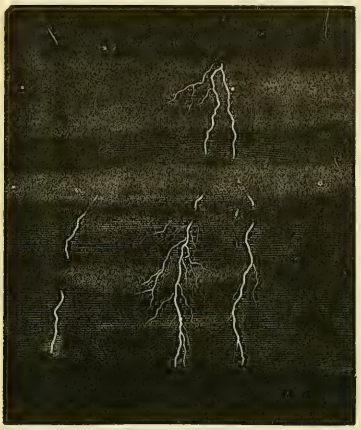

Fig. 2.

REPRODUCTION OF PHOTOGRAPHS OF LIGHTNING TAKEN AT MOUNT VERNON, NEW YORK.

It is generally supposed that in such flashes the lightning proceeds from a single point, and that it splits up into two or more distinct streams following the path of least resistance, and it is this which obtained for it the name of forked lightning. Recently, however, Dr. Kayser, of Berlin, from a study of photographs of lightning, has advanced a different theory. He imagines that several discharges take place in quick succession from earth to cloud, and from cloud to earth, and that the branches shown upon the photographs are due to the flashes passing up and down the column of air heated by the first discharge, but that in the intervals between each flash, atmospheric currents have shifted the position of the column, thus causing the branched appearance.

When ribbon lightning appears in a long rippling line it is known as chain lightning. Sheet or summer lightning is very frequently seen, and its origin has given rise to a considerable amount of controversy. It appears to be due to reflections of forked lightning at places so far away

that the curvature of the earth hides the original flash from the observer. Dr. Tyndall, while staying at Bel Alp, frequently observed sheet lightning on the horizon, and found, on telegraphing to the Monte Generoso Hotel, that terrific storms were raging over Northern Italy, and that he was merely seeing the reflection in the sky.

Another form, known as globular lightning, is sometimes seen, but as yet the conditions necessary for its production are not known. This form of lightning lasts for a much longer period than the others.

There is also a form of lightning known as the brush discharge, or St. Elmo's fire, which is sometimes seen at sea in lambent blue flames at the ends of the yards and at the mast-heads of vessels. It is also seen occasionally in the Alps, and pine forests have been known to have each little fir-needle tipped with a small lambent light, producing a weird and beautiful effect.

The colour of the flash depends upon the height and density of the air through which the discharge takes place; if in the upper strata of the atmosphere, the light is of a bluish colour; if through a stratum ladened with water vapour, the light is of a redder tint; and if the flash takes place through the denser strata of the atmosphere, the light is white and intensely vivid.

The discharge has a considerable effect upon the atmosphere; water vapour is decomposed, and some of the liberated hydrogen unites with the nitrogen in the air, forming ammonia, small quantities of the oxides of nitrogen are also produced, and in the immediate vicinity of a flash a peculiar phosphorus-like odour is noticeable, due to the conversion of a little oxygen into ozone.

It would be very interesting if photographs of the same flash could be obtained from several stations, and the Royal Meteorological Society last year invited photographers to assist them in doing so. During the violent storm we had last August a number of photographs were taken, but owing to the frequency of the flashes and the very short intervals which elapsed between them, they could not be accurately identified. We trust, however, that further attempts will be made to photograph as many lightning flashes as possible, and that they may be sent to the Society with a careful record of the direction in which the camera was pointed, as well as the exact time at which the flash occurred.

BOULDERS IN COAL SEAMS.

THE occurrence of boulders—rounded and water-worn portions of rock, carried often far from their probable origin, and deposited among strata of a very different character—is no uncommon geological phenomenon, nor in many cases is their presence difficult to account for. They have been brought by floods, or deposited by glaciers or icebergs travelling over the spots where they are found. But there are instances of boulders to which none of these explanations will fairly apply. Thus in a recent number of the transactions of the Manchester Geological Society (vol. xix., part 16, p. 404) we find an account of two boulders found fixed in a seam of coal about six inches from its bottom. Both were evidently water-worn, and were not at all like any of the surrounding strata.

These boulders were found in the Brookside Colliery, near Leigh, in Lancashire. Similar stones have been found in coal-seams at Patricroft, Pendleton, Kearsley, in the Astley Pit, Dukinfield, in Cheshire, varying in size from a few ounces up to 16 cwt.

Others very similar in character have been found in other parts of England, in the coal-beds of Saxony, Upper Silesia, Austrian Silesia, and in similar formations in the state of Ohio.

But the important question is how they can have been deposited as we find them? The beds of coal and shales in which they are embedded point to slow, gradual processes, going on probably for thousands of years. The boulders, on the other hand, must have been transported by some sudden violent agency. Now how do these facts agree together? Whatever power would be capable of bringing along these heavy stones would surely have been sufficient, and more than sufficient, to have disturbed and swept away the coal, which was in the process of formation below, and around, and in many cases also above these erratic masses. Yet there is nothing to show that the quiet formation of the coal had been in the least interrupted. If we suppose the boulders to have been brought by a flood, the sudden bursting of a lake, or the irruption of the sea in case of a sudden subsidence, what must have become of the coal? Water-worn they certainly are, but this may have been in all probability effected long previous to their deposition. It is to be noted that in most cases they are not accompanied by any other matter such as storms and floods would be likely to convey.

As regards the supposition that they have been brought by ice, we must remember that none of these stones show the slightest signs of glaciation—that is, none of the lines and scratches such as those seen on boulders from the glacial drift.

Among the hypotheses brought forward to account for their position, one is that they are not boulders at all, but concretions or aggregations, nodules in fact, formed where they lie. This view, however, in the opinion of an eminent geologist, is disposed of by the fact that some of them are not rounded, but angular, and, further, by their agreement in structure and composition with rocks from which they have probably come.

Another supposition is that after carbonaceous matter had been deposited, but not yet consolidated as it is now found, it may have been submerged, and that stones floated by masses of drift-wood and entangled in the roots of trees may have "been dropped through the water, quietly down upon the submerged vegetation at the bottom."

From the wide divergence of opinions and the absence of any theory which fully meets all the requirements of the case, it is evident that these boulders in the coal-seams require much further study.

IMPROVED PASTE.—The following is a German formula for making a liquid paste or glue from starch and acid. Place five pounds of potato starch in six pounds of water, and add a quarter of a pound of pure nitric acid. Keep it in a warm place, stirring frequently for forty-eight hours. Then boil the mixture until it forms a thick and translucent substance. Dilute with water if necessary, and filter through a thick cloth. Another paste is made from sugar and gum arabic. Dissolve five pounds of gum arabic, and one pound of sugar in five pounds of water, add one ounce of nitric acid and heat to boiling; then mix the above with the starch paste. The resultant paste is liquid, does not mould, and dries on paper with a gloss. It is useful for labels, wrappers, and fine bookbinders' use.

General Notes.

Exploration of the Eastern Andes.—Professors Kurtz and Bodenbender, of the university of Cordoba, La Plata, have set out to explore the eastern side of the great Cordillera.

Mishap to Dr. Krause.—The enterprising traveller, Dr. Krause, has arrived at Acra, on the Gold Coast, without means, having been stripped of his baggage and collections by the natives.

Tides in the Mediterranean.—The common statement that the Mediterranean is tideless must be pronounced incorrect. M. Herand has just found that in the Gulf of Gabes, on the Tunis coast, the tide rises six and a half feet, and all along the coast it is measurable.

Charge against an Examiner.—A lecturer on Anatomy, at one of the London Medical Schools, who is also an Examiner on the "Conjoint Board," is, according to the *Medical Press*, charged with having furnished the students of his class with particulars of the questions about to be asked. He has sent in his resignation.

The Telephone in Berlin.—According to the *Electrical Review*, the Berlin municipal authorities have at length permitted the Post Office to lay down underground wires through the thoroughfares, thus relieving the pressure on the aerial system.

Formation of Soils.—According to Professor Muschketoff, marmots in some countries take no contemptible part in the process of soil-making. Their heaps of earth in the steppes of Siberia cover hundreds of square miles and each one of them represents at least 2·6 cubic yard of earth upturned, or about 39,000 cubic yards on each 1,094 yards square.

A New Artesian Well.—After twenty-two years of work, says *La Science en Famille*, the artesian well in the Place Hebert, Paris, has been completed. The subterranean water was not struck until the depth of 719 metres had been reached. The shaft is 1.60 metre in diameter, the temperature of the water is 95° F., and the cost of the operations has reached 2,500,000 francs.

Rainfall in Different Parts of the World.—The continent where the rainfall is greatest is South America (1,670 millimetres in depth), then Africa (825 millimetres), North America (730), Europe (615), Asia (555), and Australia (520). The heaviest rainfall is between the equator and lat. 10 S., whilst that from 40°-50°, and 50°-60° S. is much greater than that between 20°-30° and 30°-40° S.

The Mountains of Siam.—According to Mr. J. McCarthy, a chain of mountains which runs in an unbroken range down to Singapore has peaks of 7,000 feet between Burmah and Siam, and in the Malay Peninsula one peak reaches 8,000 feet. Another chain, which forms the water-shed between the rivers flowing into the Chinese Sea, and the tributaries of the Meinam Kong, rises to 9,000 feet.

African Arrow-Poison.—M. Arnaud (*Comptes Rendus*) has extracted the active principle from the root of the Ouataic tree, belonging to the family Apocynaceæ. The Camalis, a tribe of Southern Abyssinia, use an extract of the root for poisoning their arrows. The crystalline principle extracted by M. Arnaud is so poisonous that two millogrammes suffice to kill a dog weighing upwards of 40 lbs. This poison is not an alkaloid, and contains no nitrogen.

Conversion of Nitrates in Soils into Nitrogenous Organic Compounds.—M. Berthelot (*Comptes Rendus*), infers from a prolonged course of experiments that there are two distinct, even conflicting, actions proceeding in arable soils. On the one hand, the micro-organisms of nitrification convert ammoniacal salts and nitrogenous organic matter into nitrates, whilst on the other hand certain other microbia, the antagonists of the former, are working in the inverse direction.

Tuberculized Poultry.—Dr. Stallard (*Otago Witness*) has recently observed the bacilli of tubercular disease in the liver, lungs, and other organs of chickens sold for food. From his observations he concludes that at least five per cent. of the poultry offered for sale are thus affected. The mature bacillus of tubercule perishes at 150°, so that they would be destroyed in cooking; but a very much higher temperature is needed to kill the spores of such bacilli, so that the use of tuberculised fowls as food cannot be pronounced absolutely free from danger.

Ignition of Platinum in Different Gases.—Dr. W. R. Hodgkinson, in a letter to *Nature*, states that when platinum wire was ignited in atmospheres of chlorine, bromine, and iodine a deposit of the lower halogen salt was formed on the sides of the containing vessel, and crystals of platinum were deposited on the cooler parts of the wire. When a similar experiment was made in dry silicon fluoride, long semi-transparent crystals (probably of silicon) were deposited on the wire.

Effects of Electricity on Wine.—According to *Cosmos*, Senior Mengarini has continued the researches of Blaserna and Carpini on artificially ripening wines by electric action. He passed a current of 3·99 ampères through a sample of wine for variable lengths of time. The platinum electrodes became covered with a considerable deposit of albuminoid matter blackened by oxidation. The proportion of alcohol was slightly diminished, and the bouquet of the wine was developed as if by age. The current seems to sterilise the wine, and secures its preservation.

North Atlantic Ocean.—From the *Pilot Chart* for April, published by the American Hydrographic Office, we learn that ice was met with in latitude 43° 40′ N. during March. Some of the logs of which the timber raft was composed, have been met with in the vicinity of the Azores. A cyclonic storm central about 150 miles south of Newfoundland on the 2nd, followed a very irregular path across to these islands, which it reached on the 11th; the lowest barometer was off the Grand Banks on the 3rd, when a reading of 28·40 was reported. One noticeable feature of this gale was the apparent loss

of energy after passing the meridian of 40° W., followed again by a marked increase upon reaching 25° W., east of which very low barometer and force of wind 12 were experienced.

Action of Electric Currents upon the Human Body.—D'Arsonval (*Humboldt*) maintains that continuous currents occasion permanent injury by chemical decomposition and consequent disorganisation of the tissues, whilst alternating currents might strike down the victim, but without direct action upon the nervous system, so that life could be restored by artificial respiration. Prof. von Helmholtz declares that alternating currents are the most destructive form of electric action, and gives an instance where an assistant of Halske was thrown into convulsions, and would have been killed but for the breaking of the wire. Prof. von Oettingen insists that strong currents should not be compared with an electric shock, which was much less dangerous, as followed from his own personal experience and that of Tyndall.

Utilisation of Natural Gas at Newcastle.—Last June a "blower" of natural gas was struck in the underground workings of the Hebburn Colliery, near Newcastle-on-Tyne, and remained for fully six months a source of annoyance and danger to all in the pit. At the commencement of the present year—as the flow seemed likely to be permanent—it was decided to utilise it by running a 6 in. pipe from the "blower" to the surface, and burning the gas in one or more boilers. On the 26th of February the gas was successfully lighted in a large Lancashire boiler, which has continued to work steadily ever since. It is believed that the flow is sufficient to supply four boilers, and three others are accordingly to be connected with the gas main. The gas is introduced to the boiler flue by an annular burner, the flame being afterwards broken up and spread by a brick bridge placed about 7 ft. from the front end. The evaporative power of the gas is great, and the arrangement, when complete, is expected to result in a saving for fuel and labour of about £3,000 per annum.—*Industries.*

New Dynamite Gun.—We learn from the *Army and Navy Register* that Mr. H. S. Maxim has devised a new dynamite gun, in which he proposes to introduce a new and interesting mode of expelling the projectile from the weapon. He retains the pneumatic principle which has been utilised with so much success by Zalinski, but instead of using compressed air alone, as Zalinski does, he mixes with this compressed air a quantity of a volatile hydrocarbon, such as the vapour of gasoline. This compressed mixture is introduced behind the projectile, and the pressure applied starts it forward in the chamber of the gun. After it has moved a certain distance, the projectile itself uncovers a detonating fuse, and an explosion then occurs, the air furnishing the oxygen for the explosion, and the pressure being increased about eight times. He claims that by this method his initial pressure does not need to be more than half as great as that used by Kalinski. He does not have to use so much compressed air, nor does he require that the barrel of his gun shall be of such great length. His highest pressure is about 4,000 lbs. to an inch, the first pressure being not more than one-tenth of that. His detonator is a very ingenious affair, and is inserted through a small circular opening from the interior of the gun.

Relations between the Atomicity of the Elements and their Biological Action.—Dr. J. Blake (*Comptes Rendus*) finds that the monatomic elements act principally upon the pulmonary arteries, the biatomic elements upon the voluntary and cardiac muscles and the centres of vomiting. The only biatomic element which acts upon other nerve centres is glucinium, a metal which in its oxygen compounds occurs probably in a trivalent form, a point upon which chemists are not unanimous. The triatomic elements act upon the respiratory, vasomotor and inhibitory centres, upon the cardiac ganglia and the pulmonary arteries. Lastly, the tetratomic elements act upon the respiratory, vasomotor, and inhibitory centres; upon the brain, the spinal marrow, the cardiac ganglia, and the pulmonary arteries. The author has previously shown the important *rôle* of isomorphism, and of atomic weight in the action of the elements upon living tissues, and we may now regard atomicity as another important factor. When Newlands published the law of periodicity he remarked that all the inorganic elements found in organised bodies have atomic weights inferior to forty. We may now add that all the electro-positive elements found in organised bodies are monatomic or diatomic.

Travellers on the Congo.—The *Mouvement Géographique* publishes a very interesting report of a voyage of exploration undertaken by Captain Van Gèle and Lieutenant Lienart, both of the Belgian army, who went up the River Ubangi in a small steamer capable of being taken to pieces and carried overland when required. The *En-Avant*, as this steamer was called, left the Equator Station on the 26th of October last year, and reached on the 21st of November the Congo Rapids, a point which had already been reached by the English missionary Grenfell in 1884 and by Captain Van Gèle himself in 1886. It was at this point that the difficulties began, for after leaving the Congo behind them the explorers had to get through, or rather over, six rapids, divided from one another by navigable basins. At the last of these rapids the stream is nearly 3,000 ft. in width, and has an average depth of about 18 ft. for nearly thirty miles, at which point it follows a course due east for a distance of 170 miles, which was the extreme point reached by the *En-Avant*. The explorers describe the country through which they travelled as being very fertile and picturesque, while the inhabitants treated them with great kindness until they got as far as the tributary of the Bangasso (21 deg. 23 min. east longitude Greenwich), from which point the attitude of the natives became very hostile. Upon the 1st of January they had to repel their first attack, losing two of their men, while five days later they were attacked by land and water. They were then at 21 deg. 55 min. east longitude, or within one degree of the point reached by Junker upon the Uellé, so that only seventy miles had to be traversed to connect the two points and elucidate the problem of the two rivers, the Ubangi and the Uellé. But the state of the steamer, the shallowness of the water, the extraordinary density of the population and its very hostile attitude made this appear too great a risk to be worth running, and Captain Van Gèle and his companion accordingly returned down-stream, reaching the Equator Station on the 1st of February.

KEELING'S SEWER-GAS DESTRUCTOR.

THE object of this simple contrivance is twofold: it ventiliates the sewer and at the same time burns or destroys the organic matter held in suspension by the discharged gases. Fig. 1 represents the working part of the apparatus to the scale of one inch to one foot. Within the lowest of the cones is an atmospheric gas-burner, and above this is an open metal grating leading to an upper cone, and a similar arrangement is adopted between the middle and uppermost cones. The vertical pipe shown in section at the base of the apparatus represents an outlet from the sewer, and when the gas-burner is alight its ascending products of combustion cause an induced upward current of sewer-gas, as indicated by the arrows. At the same time the grating

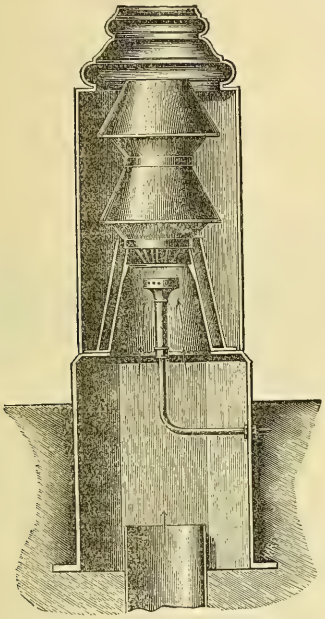

FIG. 1.—SECTIONAL VIEW OF DESTRUCTOR.

above the burner becomes highly heated, and it follows that the sewer-gas either comes in contact with the flame or with the heated metal. If a piece of lead is placed above the grating it melts, and this proves that the temperature there is above 600° Fahrenheit, and the effect of this is either to burn or destroy poisonous organic matter emitted from the sewer. To assist the upward draught, the heating apparatus is surmounted by a hollow column, to which can be given the form of a lamp-post, as in Fig. 2, there being openings for the escape of the gases immediately under the lamp.

Several of these destroyers have been tried at Richmond, and, according to Mr. Brooke, Surveyor to the Vestry, the average consumption of gas for each one is about seven cubic feet per hour. He also states that by means of an anemometer he finds that from 250 to 300 cubic feet of sewer-gas leave the shaft each minute, and that the temperature in the upper cone is above 300° Fahrenheit. He adds that each destroyer is able to clear the foul gases from a length of 1,500 to 2,000 feet of sewer. According to this it would appear that, with an expenditure of only 168 cubic feet of gas, costing about sixpence, a discharge of from 360,000 to 420,000 cubic feet of sewer-gas can be effected in twenty-four hours. As the discharged gases were measured at a comparatively high temperature, the above figures do not represent the actual

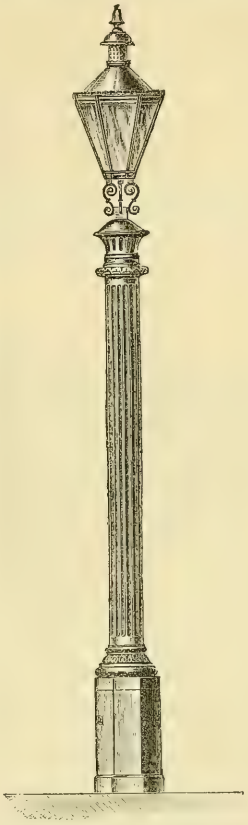

FIG. 2.—DESTRUCTOR WITH HOLLOW COLUMN IN THE FORM OF A LAMP-POST.

volume displaced at the ordinary temperature of the sewer, but, after allowing fully for such a correction, the result cannot but be considered as very satisfactory.

Mr. Brooke states that in the Kew Foot Road the men found it impossible to go into the sewer before the Keeling shaft was erected, but that within one week after the latter had been in operation they were able to work there comfortably. As a ventilator there can be no doubt as to its efficiency, nor is it very surprising that it should be so, as the principle of its action is a sound one, and has long ago been applied to the ventila-

tion of buildings. It is also tolerably certain that all or nearly all the poisonous organic matter is destroyed. Doubtless so much of it as comes in actual contact with the flame is burnt and effectually destroyed; it is also probable that so much of it as comes in contact with metal surfaces heated to 400° or 500° Fahrenheit is also oxidised, and therefore rendered harmless; the only doubtful portion, therefore, is a small proportion of the sewer-gas which travels upwards at a high velocity, and may neither touch the flame nor the heated grating above the burner. Even if it escapes contact in this way, its temperature must be considerably raised, and for all practical purposes there can be little doubt that all deleterious matter is removed from the sewer-gas.

The usual method of ventilating sewers by means of gratings in the roadway is not only disgusting, but injurious. On the other hand, mere ventilating columns or pipes cannot be relied on, as they are so easily affected by varying conditions of the atmosphere. It is decidedly a right idea to insure a regular discharge, as there is then a constant ventilation of the sewer, and if at the point of discharge the organic matter, which is the carrier of disease germs, is destroyed, the system leaves little to be desired. The invention now under notice has been introduced by Mr. Stephen Holman, C.E., of 15, Great George-street, London.

MARINE EXPLORATIONS IN THE ADRIATIC.

THE explorations conducted by Professors Julius Wolf and Joseph Luksch during the years 1874 to 1880 have been summarised by Captain Rottok, and published in abstract in *Humboldt*. These researches include determinations of temperature; of specific gravity and proportion of salts; of the transparency and the colour of the waters and of the currents.

Observations of temperature were made at more than 150 stations, both on the surface and in depths. The temperature on the surface and in the immediately subjacent layers of water increases in summer on the Italian coast, and along the axis of the sea by 2° to 3° C. from north-west to south-east. It was also found that the water on the western side was warmer than on the eastern. The decrease of temperature from the surface to the bottom is, at first, as is usual, rapid, and amounts to 10° C. for the first thirty fathoms. Then it becomes very slow, and is only 2° C. as far as eighty fathoms. On the bottom the temperature generally follows the relief of the ground. Only in the north-eastern part of the Adriatic there prevails a temperature which is very low in proportion to the depth. From this circumstance, viewed in connection with the small specific gravity of the lower strata of water, we may infer the existence of cold springs at the bottom. A constant temperature is found only in the very largest strata. In winter the distribution of the temperature in depth is different from and more uniform than that observed in summer, probably in consequence of the more active vertical circulation. In the cold season the differences of temperature were much slighter than in summer. Sometimes there was even found a slight rise of temperature on descending, or, at any rate, a uniform heat. Spring and autumn formed naturally periods of transition. Spring, however, retains the character of the past winter, as the perpendicular variations of temperature are feeble and slow. Autumn approximates more to the character of summer in a rapid perpendicular decrease of temperature.

The observations on the specific gravity of the water and the proportion of saline matter in solution were less numerous than the determinations of temperature. Still, they sufficed to show the general character of the density of the water.

Like the temperature, the salinity of the water on the surface increases in summer from the north-west to the south-east, but, contrary to the temperature, it is greater on the Dalmatian than on the Italian coast.

The distribution of saline matter in respect to depth is very irregular, as might be expected, from the different currents, the entrance of rivers and springs and other local conditions affecting such a narrow sea. In general, the proportion of salt increases from the surface to the bottom, but the increase is very unequal, and sometimes interrupted by a decrease. In the winter, observations were made only at Quarnero, and the result showed a much more uniform distribution of saline matter than in summer.

The transparency of the water was determined by immersing polished or painted discs of metal. In the two series of observations made, the depths at which the discs ceased to be visible were between thirteen and twenty and a-half fathoms.

The colour of the Adriatic is dark blue by transmitted, and intense blue by reflected light.

The surface-currents were determined, not by direct measurements, but indirectly from the observed distribution of heat and salinity, taking into account the meteorological relations, the access of fresh water from the shore, the configuration of the bottom, and the rotation of the earth. Direct measurements gave no satisfactory results, since the results were interfered with by other factors.

The ordinary supposition that there occurs along the coasts of the Adriatic a circular rotation of the water in the opposite direction to the hands of a watch was confirmed. Along the western coast a mass of water, poor in salts, flows towards the south-east, approaching, as it advances, more closely to the shore, becoming also narrower and deeper. A current of more saline water, coming from the Mediterranean Sea, runs along the Dalmatian coast in a north-western direction. It is, however, often diverted from its course by the numerous islands. Thus at certain points branches of the current turn off to the west, and then to the south-west, uniting with the counter-current on the opposite coast.

THE PHENOMENA OF ZYMOTIC DISEASE. — The opinion is now gaining ground that the so-called "disease-germs" do not occasion fevers, etc., by their own mere presence in the blood, but by certain definite chemical compounds which they produce. These bodies ultimately prove fatal to the germs themselves—a phenomenon by no means unexampled. This view likewise explains why any animal which has once recovered from such a disease is generally, for a term of years at least, proof against a second attack. It is even suggested by MM. Chantemesse and Vidal, that the peculiar compounds elaborated by such microbia may be isolated, if not perhaps artificially manufactured, and may serve to render man refractory to the attacks of disease-germs.—*Journal des Debats.*

Natural History.

POISONOUS FISHES.—I.

The Weever.

IT is a somewhat remarkable fact that poison, employed either as an offensive or a defensive medium, is not met with among those which we generally term the higher animals. The claws of the tiger, it is true, when employed against a human foe, frequently cause symptoms which cannot be attributed to the mere laceration of the flesh; and the same is the case, although less commonly, with the corresponding weapons of the lion. But the results in question—lockjaw in fatal cases, and a periodical re-opening of the wound in those in less severity—cannot be traced to the operation of any actual poison. The claws are not channelled or perforated, neither are they furnished with venom-secreting glands. And the strange after-effects which so frequently ensue from the wounds which they cause are in all probability due to a species of blood-poisoning, arising from their frequent employment in tearing putrid carrion; so that they become envenomed for a time, just as does the dissector's scalpel, although not by the hand of Nature.

In birds we do not meet with poison at all, in any form or shape; their weapons consist of talons and beak, assisted, in a few exceptional instances, by the wings or the legs. In the reptiles, however, we find that it is present, first in one of the lizards (*Heloderma horridum*), and afterwards in many of the snakes; and in the fish it is not at all infrequent, both in an offensive and a defensive form. Among invertebrate animals it is common enough.

In many poisonous fish, however, is this strange peculiarity, that the actual venom itself cannot be detected. The weapon of transmission may be channelled or perforated, as in the formidable spines of the Weever fish, but no glands can be found in connection with them. And yet it seems absolutely certain that some poisonous medium is injected into the wound.

This subject has received very careful attention from Professor Allman, who expresses his firm belief, based on long experience and investigation, that actual venom is secreted, although he has not succeeded in finding glands specially appropriated to such a purpose. "The spines in the gill-covers of the weaver," he says, "are deeply grooved along the edges, and each groove terminates at the base of the spine in a conical cavity excavated in the posterior edge of the bony part of the operculum. In the sides of these excavations," he proceeds to say, "the edges of the grooves lose themselves, so that there is a perfect continuity between each groove and the corresponding cavity. From the posterior edge of the operculum the integument is continued over the spine to within a very short distance of the point, by which means the spine is enclosed in a complete sheath for nearly its entire length, and the groove at each side is converted into a perfect tube, extending from the conical cavity at the base almost to the point of the spine. Yet," says the Professor, in conclusion, "I have not been able to detect any specific gland connected with this apparatus."

It is difficult, if not altogether impossible, to believe that a structure such as this, so similar to that which we find in the case of the venomous serpents, and in other poison-bearing animals, does not fulfil corresponding functions, more especially when we take into consideration the consequences ensuing from the wounds which these spines inflict. A mere prick from the "sting" of a weever fish will cause the wounded limb to swell to nearly double its size, while the dull, throbbing pain, which is often most severe, will continue for days, and even weeks afterwards. If the recipient be already in feeble health, death itself may very possibly follow. And so well known are the powers of the fish that, both in France and in Spain, the removal of its dorsal fin and the hinder portions of the gill covers is rendered obligatory immediately upon capture, in the former country by police regulation, and in the latter by statutory law.

The Weever (Trachinus Draco).

It were idle to assert that results such as those described could be due to a mere insignificant puncture, no more alarming in itself than the prick of a moderately large pin. Yet the fact remains that no actual poison has been or can be detected, either in the spines themselves, or in the cavities at their roots. Professor Allman, it is true, states that in each of these cavities is a small pulpy mass, which may or may not be glandular in character; but he evidently inclines to the latter belief. He also suggests that the virus may possibly be secreted by the pulpy sheath of the spine; but this, as he himself admits, is nothing more than mere conjecture. And the question at present stands over for solution by some future investigator.

(*To be continued.*)

The Eyra Cat.—The cats are one of the many difficulties of the zoologist. Despite much ink shed, it is still undecided whether the family *Felidæ* contains but the single genus *Felis*, or whether it comprises several distinct genera such as *Felis* proper (the tiger, leopard, jaguar, etc.), *Leo Cynailurus* (the hunting-leopard), and *Lynx*, including a number of short-legged species with long fur and tufted ears. Even if we waive the dispute as to genera, there springs up another on the number of species. It is asked, for instance, whether the leopard, the panther, and the ounce are three distinct species, and are merely local variations of one and the same creature? Is the jaguar of South America a single form, or do we confound under this name three distinct cats differing in their markings, which moreover do not associate together, and which "breed true."

Perhaps the difficulty of distinguishing both species and groups among the *Felidæ* springs from the fact that they are the most recently developed family of carnivorous animals, and have not yet had time to become duly differentiated. Perhaps in a thousand centuries, if they have not by that time been "improved off the face of the earth," marked distinctions will have appeared between different groups. Even now we may perceive departures from the normal cat type; whether these departures are the surviving remnants of some missing link, or approximations as yet rudimentary, we cannot say.

Thus the hunting-leopard or cheetah of India and Africa differs from the true cats, and approaches the dogs. Its claws are not retractile, its forehead is more convex, and its disposition and manners are more like those of a dog.

Another departure from the typical cats is the "Eyra cat" of South America, a specimen of which is now to be seen in the Zoological Gardens. This animal would, at first glance, be taken by most observers for a near kindred of the weasel and the pole-cat. Its head is smaller and more pointed than that of the domestic cat, which it closely approaches in size. Its body and tail are both longer, and it stands lower. Its entire structure seems adapted for climbing and making its way into holes and crannies. Mr. Tegetmeier, writing, in the *Field*, thinks that the Eyra "might easily be domesticated, and would make a graceful addition to our domestic fauna." We should earnestly deprecate its naturalisation, since it is, from all accounts, which the structure of the animal fully corroborates, a better climber and a more eager bird-hunter than even the common cat. In the interest of our small birds, as well as of game and poultry, it ought not be tolerated in a state of freedom.

Opposition to Evolution.—The *Courrier de l'Europe* remarks that the Paris Academy of Sciences includes in its ranks two obstinate opponents of the doctrine of organic evolution, MM. de Quatrefages, and Emile Blanchard. The latter savant has just attempted to renew the struggle in a work entitled, "*Conditions de la Vie, l'Origine des Etres.*"

Creeping of Gasteropods on Water.—According to Victor Willem, the fresh-water gasteropoda, in order to creep in an inverted position (back downwards) upon, or rather beneath, the surface of water, support themselves at first upon the thin superficial film which always covers the water of ponds. They then creep on the lower side of a thin carpet of mucus which their foot secretes as they proceed.

Colour Variations of Alpheus.—One species of this prawn, according to Mr. F. H. Herrick (*Morphological Notes, John Hopkins University*) seems to assume different colours according as it inhabits a brown or green kind of sponge. Those living in the former produce yellow eggs, and have their large claws red, blue, or brown. The form inhabiting the green sponge deposits green eggs, and has its large claws always of an orange red.

A Month in Pal'awan.—Mr. J. B. Steere, (*American Naturalist*) having spent a month collecting in Pal'awan, considers that it is much more nearly allied zoologically to Borneo than are the other Philippines. The Bornean look of the birds is quite apparent. The author remarks that tropical species of birds seem much more closely limited to specific kinds of food than are those of colder climates. He collected 120 species of birds, five of mammals, three of amphibians, six of lizards, nine of snakes, thirty of butterflies, a few small and inconspicuous beetles, scorpions, and centipedes, ten or twelve corals from the bay, and a number of fine land and tree shells.

The Multiplication of Hydroids.—Dr. W. K. Brooks (*Morphological Notes of the John Hopkins University*) points out that in the hydroids, as in other animals which pass through a metamorphosis but also multiply asexually (*e.g.* by fission) at any stage of their life-history, the new organisms thus produced do not repeat in their own life-history those stages which the parent organism had already passed. If the life-history of the species from the egg to the adult consists of a series of larval stages A, B, C, D, E, and if when the larva has reached C it multiplies asexually, by budding or splitting off, the asexual progeny do not pass through the stages A and B. In most cases they begin their life at the stage C, and repeat in their own ontogeny only so much of the life-history as still lies before the parent, that is, the stages C, D, and E. In other cases they outstrip the parent and pass at once to the stage D or E.

Local Modifications in the Plumage and Eggs of Birds.—Mr. H. Kerr (*Newcastle Weekly Chronicle*) is of opinion that moor-land feeding birds are darker plumaged than those which are bred and fed in the lower and richer grass and arable lands. North-east Lancashire larks are small, dark-plumaged birds; their eggs are smaller and darker than those of the larks of South Lancashire and Cheshire, where the feeding is more generous. Kentish skylarks' eggs are a good deal larger and lighter in colour than those of the North-east Lancashire skylarks.

Criminal Biology.—The *American Naturalist* raises the following questions: What categories of criminals may we distinguish, and what are the fundamental characteristics, physical and psychical, which they display? Is there a general bio-pathological constitution which predisposes to the commission of crime? how does it originate and what form does it assume? Does the number of suicides stand in an inverse ratio to the number of homicides? Epilepsy and moral insanity in prisons and asylums? Utility of a museum of criminal anthropology?

THE CRYSTALLINE LENS OF THE HUMAN EYE. — Dr. Tscherning (*Comptes Rendus*) has investigated the position of the crystalline lens of the human eye. The crystalline is placed obliquely with reference to the visual line, the centres of the curvature of its surface not being found upon this line. This deviation causes a slight degree of astigmatism which is generally compensated by the astigmatism of the cornea when it, as usually occurs, is more convex in the vertical than in the horizontal meridian.

APPEARANCE OF THE HOOPOE IN ENGLAND.—We learn from the *Field* that this spring—if we may venture so to call it—three specimens of the hoopoe have been seen in England—in Kent, Isle of Wight, and Bucks, respectively. One at least of them has been shot. It would be well, if in addition to the "close time" for birds—which is little more than nominal—certain species, such as the hoopoe, the roller, and the golden oriole were placed on an absolutely prohibited list.

CROW ROOSTS AND CROW ROOSTING.

WITHIN the past few years much has been written concerning the common crow (*Corvus Americanus*) as regards its relation to man; but until recently little or nothing has appeared pertaining to the roosting-places of one of our most common birds. It is not generally known, even among those who consider themselves somewhat acquainted with the species, that during the winter they congregate in vast numbers at some chosen spot, scattering during the daytime in quest of food, but returning at night to seek rest and protection in each other's company.

It has been my good fortune to visit two such rookeries, and to observe closely the birds composing it, both at the roost and at a distance, so that a fair idea has been obtained of the place under nearly all circumstances.

The first of these two that I have mentioned is situated about two miles east of Syracuse, N. Y., in a wood known as "Tamarack Swamp," and lying between the Central and West Shore tracks. This swamp, once extensive, has been cut down to a narrow strip not exceeding four hundred yards in width by one and a half miles long; hemmed in on the north and south sides by hills, and drained by two constantly flowing streams, it has become what is known as a dry swamp, composed of maples, pines, birches, elms, beeches, tamaracks, and oaks. Midway in this strip is a stretch of young pines, averaging twelve feet in height, and this spot, in preference to the more densely wooded portion, has been chosen as the winter home by the crows. The second (for I wish to draw a comparison between the two before proceeding further) is situated in Arlington Cemetery, at Washington, D. C. Here the ground is entirely different. Not only are the trees of a greater height and of a different variety, but the place itself is located on a hill-side fully a hundred and fifty feet above the water, and facing the Potomac River, from which it is distant scarcely an eighth of a mile. The only points of semblance between the two are that it is on a low elevation in a slight ravine which, being drained by two small streams caused by the elevation, is also perfectly dry. Both rookeries are nearly equal in size, the one at Syracuse covering about fifteen acres, and that at Arlington from ten to twelve.

A visit to these roosts in the daytime is interesting in the extreme, while another paid at dusk, when the birds are coming in, is even more so.

For convenience in description I shall start with the birds at early morn, following them throughout their wanderings until their return at night. Shortly after daybreak the vast throng of black bestirs itself; first a loud clamour betokens that the birds are awake; then with a shake or two they launch forth in quest of the morning's breakfast.

Leaving singly, in pairs, by dozens, and in flocks of hundreds, each group wings its way to where the previous day's meals were secured, or starts in search of new feeding-grounds. After they are gone the roost is a sight indeed. On every hand the trees and ground beneath are literally covered with the excreta of the birds, having much the appearance of having been plentifully bespattered with whitewash. The air is foul with the odour, mingled with that of the putrefying bodies of the dead ones that here and there dot the snow, while among the branches, as well as on the ground, are numbers of individuals too weak, emaciated, or otherwise disabled to participate in the daily flight. These are readily approached, and are often to be caught in the hands.

Nowhere outside a rookery can a fair idea be obtained of the gregarious nature of the crow, for here on every hand is abundant evidence of this trait. Not only does the roost surround us, but the departure of the birds in flocks, and the finding of them together subsequently in the day, is of itself enough to establish this fact.

A drive through the surrounding country will now give a glimpse of their daily life during winter. Anywhere and everywhere they may be seen, each in search of that which alone will sustain life; but, with the usual frozen condition of the ground, this, as a rule, is difficult to obtain. Along the rivers and streams they may be seen walking on the ice in search of a possible dead fish or a stray mussel; breaking through the ice, where not too thick, in order to get at the unfrozen mud beneath; and in many places the surface for a considerable area resembles the land more than the ice, from the quantities of this material thrown out. Here they of course secure considerable vegetable matter, mingled with an occasional shell-fish; but the supply is poor at the best, for presently they take wing and fly to a barren field, where for a brief period they turn over the frozen lumps of earth, or endeavour to dig into the icy ground itself. At this season of the year there is scarcely a spot unvisited by them, and the distance travelled in going to and from their feeding-grounds is surprising. I have seen them at a distance of some twenty miles, high in the air, winging their way in the direction of the roost, and have no idea how far they may have come before they were observed. Up to about three o'clock the birds are busy feeding, and the average person would hardly believe that within an hour, or even less, these same birds will be miles away, and in company with tens of thousands of the same species. At this time an inclination to move is manifested by a few who fly away just over the tree tops, calling loudly as if to induce the rest who still tarry to follow. These, too, soon depart, and by four o'clock or half-past, the sky is filled with the host *en route* for the rendezvous. An idea can best be gained now of the countless numbers that nightly resort to this place, for although it is impossible to attain anything like accuracy as to the numbers, we know that at this one place hundreds (and often thousands) pass over

our heads, until it seems as if every crow in the country was being observed; but a station in an exactly opposite direction the next day will reveal a like number, and another the next day the same, until every point of the compass necessary has been covered, and as they return every night in the same direction, it is of course evident that the same flocks are not observed twice.

Having now traced them through their daily wanderings, it is in order to visit the roost again at nightfall and watch them come in. To secure the best results it is advisable to be there by 4.30 at the latest, and to take a stand in the centre of the place, close beside some tree, in order to be the less easily observed. At the hour above-mentioned they begin to arrive, either singly or in flocks, tarrying at times at some near at-hand feeding-grounds, but soon seeking the vicinity of the roost. Strangely enough, instead of repairing at once to their night's resting-place, they gather in immense multitudes on the surrounding hills; coming as they do from all quarters of the country, the numbers increase, until the fields, the trees, and the fences are covered with them. Long after the sun has set they continue to arrive. The noise is deafening, and when at times they rise and circle about in the air, it seems as if the heavens themselves were about to fall. As darkness begins to settle, first a few of the bolder ones enter the roost. These are followed by small bunches of fifty or so, and these in turn by other companies, interspersed with stragglers. Suddenly, with a noise as of a hurricane, a vast host arises and makes a dive for the roost. These are closely followed by another, and another, and still another, until finally the numbers on the hill-sides begin to show some signs of thinning out. As the darkness deepens, they come in any way; down they come pell-mell, brushing past the face, almost flying against one, alighting on the first branch they strike against (for they are now almost unable to see, and it is amusing to see hundreds flopping about waiting for luck to throw a branch in their way), often within arm's reach. Every tree and branch seems packed with them, and still they continue to pour down, finding a roosting-place somewhere, and adding clamour to the deafening babel already existing. Finally, all appear to have arrived, and are busy settling themselves for the night. Utter now but so much as a syllable, and the entire army, with renewed cries and in the direst confusion, takes wing, and seeks another part of the woods, only to renew the performance should the operation be repeated. I have never as yet remained in a roost long enough to ascertain whether or not the birds become absolutely quiet. I have remained until quite late, and on coming away could hear them for some distance, and doubt exceedingly if there is an hour throughout the night when there is not more or less noise and confusion existing. It might be well to add that these roosts are occupied each succeeding winter, the birds beginning to congregate with the approach of cold weather, and remaining until the milder approaches of spring.—*Scientific American.*

PREPARATION OF PEROXIDE OF HYDROGEN.—A new process for preparing peroxide of hydrogen has been patented in Germany by Siegfried Lustig, of Breslau. It is briefly as follows:—Zinc amalgam is shaken with alcoholic solution of sulphuric acid and air. The mercury and the sulphate of zinc which is formed, and is precipitated in the alcoholic liquid, is removed by filtration, and the liquid concentrated in vacuo. It then represents an alcoholic solution of peroxide of hydrogen.

WORK FOR NATURALISTS' CLUBS.—I.

THE old-fashioned ways of managing Naturalists' Clubs have become tiresome. When it was a new thing to examine, ever so slightly, the animals and plants of an English county, people were naturally well-satisfied to ascertain what species could be found in their own neighbourhood. All that is now done with more detail than is requisite for any scientific investigation that is likely to spring from it. Mere naming of species will not keep up a healthy activity, nor will records of occurrence, nor yet dates, never so full, of arrival of migrants, or blossoming of flowers. The work that comes handy to a man whose mind is only half-awake is no longer worth doing at all.

It must be admitted that the quality of biological work has risen so rapidly during the last fifteen or twenty years, that the untrained amateur can hardly spend his time on any sort of work that good judges will look at. There was a time when a tolerable herbarium, or collection of butterflies, a microscope, and a cabinet of bought slides, made a decent stock-in-trade for the provincial naturalist, but something more is expected now-a-days from every one who claims to be a worker. What can be done to find profitable occupation for the thousands, who, having no highly special education and little leisure, have, nevertheless, the passion for natural objects, and the wise ambition of spending their spare time upon something that brings a fit reward? Probably there are among our readers some who put this question with a practical intention of putting any likely suggestion to the proof. We shall be glad to tell them what we have learnt from a rather lengthened experience of Naturalists' Clubs.

The papers read before these little societies are, as a rule, very disappointing, for, in general, they are either built upon the writer's private fads, or they consist of mere extracts from text-books enlivened by cheap reflections. It is not to be presumed that any club can often command services of a lecturer who is thoroughly well worth listening to.

Nor is the publication of local lists a resource of any value. This kind of literature is terribly overdone. Who, we wonder, will ever be induced to systematise the interminable records of our publishing societies for the sake of any general results that they may chance to contain? These records, so copious and so dry, will become obsolete before ever they are turned to scientific account.

It would seem that by discouraging the ordinary modes in which the activity of a local club shows itself, we are hinting that the clubs themselves are of no use, but this is far from our intention. We believe that excellent work may be done by those who are willing to confederate themselves, not for display in any form, but for quiet drill under competent instructors. There are few large towns where some one person cannot be found who can give practical help in the management of a microscope. A young doctor can be persuaded to show beginners how to handle a scalpel. Or a good amateur photographer may be at hand who has some practice in microscopic work. If such talents as these can be commanded, a wide field of useful occupation is opened up. Never mind what becomes of the papers, the catalogues, and president's addresses. Set up a convenient room, buy out of the subscription-money the indispensable tools, and learn what biological work means. A weekly

evening under competent direction will soon get a likely student past his elementary difficulties.

If no more is done than this, the result may be far from contemptible. We have known a village club, in which the directing spirit was the classical master of a neighbouring grammar school, who had himself taken out an elementary biological course at the University. He gathered young fellows about him, and they dissected, mounted microscopic objects, rambled out together, and made collections. It would be hard to name a field-club which was more thorough-going, or more enthusiastic. Unfortunately, the fortunes of the enterprise turned upon one man only, and when he went all was over.

As soon as elementary methods have been mastered, a wide field is open to the amateur student. We will name a few of these, in which real skill is attainable with a moderate expenditure of time. All require some apparatus, which may tax a private purse too heavily.

1. *Microscopic Photography.*—This is becoming absolutely necessary to the worker who has important results to communicate, and it would be a real service to science if skilled amateurs could be found to aid the investigator by reproducing his preparations.

2. *Preparations of Rock Sections for the Microscope.*—This is more difficult, and means plenty of hard work. Very important results might be expected if practised operators could be persuaded to work for competent petrologists.

3. *Microscopic Section-cutting* (with the freezing or the rocking Microtome).—A short course of instruction by a good hand is simply indispensable, but once learnt the art may be practised with great ease.

4. *Experiments on the Physiology of Plants.*—Our recent article on Nutrition of Plants (SCIENTIFIC NEWS, page 421) gives some idea of what can be done in this department.

It would be easy to add other subjects which a working club could prosecute with success. But none of these plans will prosper unless there are experienced persons to guide the early steps, and some elementary training should be insisted upon, if only as a means of finding out who are really fit for special work. Our proposals will not interest those who merely seek a place in the country newspaper, but they may be of use to such as are trying to help one another along the difficult path of practical work in Natural History.

We propose to point out from time to time under the heading of "Work for Naturalists' Clubs," objects which may profitably engage an actual working club. No highly specialised knowledge will be required, but the methods practised in an elementary course will be taken for granted.

Reviews.

Researches on Diamagnetism and Magne-crystallic Action. By John Tyndall, D.C.L., LL.D., F.R.S. New Edition. London: Longmans, Green and Co. 1888.

These researches, the first series of which were published in 1850, are the result of the earliest experimental work of one who will always be known as one of the ablest experimenters of his day. As continuations of the work of Faraday, they are of considerable interest to the student who can afford to give time to one of the branches of science which has up to the present given but little signs of bearing any fruit that will be of practical service. Faraday was one of those true men of science who worked for the sake of working, and laboured for the mere love of knowledge. That there are not more such men is due largely to the fact that many of those who have the requisite genius are compelled by their circumstances to use their talents in searching for new discoveries of a useful character, which will be commercially valuable. Such a man, for example, was James Watts. Had Faraday been compelled to devote his attention to work which appeared likely to lead to useful results, we certainly should not have had his researches on diamagnetism, and in all probability the invention of the dynamo, and scores of other applications of the highest value, would have been delayed.

Diamagnetism may be briefly described thus. Bodies may be divided into two classes, which are called paramagnetic, or simply magnetic, and diamagnetic. Iron is the most paramagnetic substance, and nickel and cobalt and certain other metals are so to a less degree. These substances are attracted by an ordinary magnet, and a little bar will place itself between the two poles of a magnet lengthwise, thus allowing the magnetism to "flow through" it, to use a convenient but probably inaccurate expression. Bismuth, on the other hand, is the most diamagnetic substance, and is feebly repelled by a magnet; a bar of bismuth will place itself across the poles of a magnet. Other substances, including liquids and gases, may be arranged in a list, or a double list, iron heading the one, and bismuth the other. Such lists may be found in any text-book of electricity, but that is not a sufficient reason to account for the absence of such a list from the book before us, which merely refers to the lists arranged by Faraday and others. The explanation which Faraday gave was that a magnetic medium probably exists in space, and that magnetic (or paramagnetic) substances are more magnetic than this medium, while bismuth and the diamagnetic substances are less magnetic, and therefore exhibit opposite properties. A precisely analogous case is familiar to us in the floating or the sinking of bodies in water. A body heavier than water will sink, being attracted to the earth with greater force than the surrounding water; but a cork will rise, not because it is repelled by the earth, but because the water is attracted more strongly. The author combats this theory, and gives his reasons in a letter addressed to Faraday, who was not convinced; and, without disrespect to Professor Tyndall, we venture to say that Faraday's explanation is still generally accepted.

"Magne-crystallic force," to use Faraday's own words, "appears to be very clearly distinguished from either the magnetic or diamagnetic forces, in that it causes neither approach nor recession, consisting not in attraction or repulsion, but in its giving a certain determinate position to the mass under its influence, so that a given line in relation to the mass is brought by it into a given relation with the direction of the external magnetic power." It is found that most crystals, whether generally magnetic such as carbonate of iron, or diamagnetic as saltpetre, the optic axis will set itself in a definite position with respect to the poles of a magnet. In carrying out experiments, the crystals are generally rubbed down to the form of a ball, that any general attraction of their mass may not interfere with the result. Numerous precautions have to be taken to ensure

purity, and these are detailed in the accounts of the researches.

It is a matter of considerable regret that, in issuing a new edition of this work, it has not been brought up to date by the expression of the electric currents in ampères, instead of by the number of cells used, even if measurements of the strength of the magnetic fields could not have been in terms of the units which are familiar to all electricians. For this reason the work has little interest beyond that of a purely historical character.

Science Sketches. By David Stare Jordan. Chicago: McLurg and Co.

These sketches are almost exclusively biological, but, we regret to add, quite as exclusively ichthyological. Mr. Jordan seems to be quite as devoted to fishes as was the late Frank Buckland. This very much reduces the interest of the essays before us. Fish, and, indeed, all purely aquatic forms of life, have their being in what after all must be regarded a different world from ours. They come in contact with us at few points only, and, as far as they are concerned, that most popular division of Natural History which treats of the habits, the senses, and the psychology of animals is almost a blank.

The essay on the "Nomenclature of American Birds" is interesting. But why American? Surely a correct system of nomenclature should apply to the birds of the world.

The author says little on the question whether a binomial or a trinomial nomenclature is to be preferred, but he defends a Code recognised by the American and the British Associations against the strictures of Prof. Gill. He is scarcely correct, however, in his remarks on Canon xvii. of the Code, one clause of which is to the effect that a name founded upon the male is to be preferred to one founded upon the female; one founded on the adult to one founded on the young; and one founded on the nuptial condition to that on the pre or post-nuptial condition. We dispute his remark that in most groups of animals we "cannot discriminate in any such way between males, females, and young." In insects which form the round numbers of the animal kingdom we can, quite as readily as in birds. We notice the happy remark, "Literature deals with manner, whilst science treats of matter."

The next paper, entitled "An Eccentric Naturalist," gives an account of the doings of Constantine Samuel Rafinesque.

This man, born in Constantinople of a Franco-Turkish father and a Græco-German mother, is paradoxically said by our author to be an American! Whatever his nationality, he was a botanist and a zoologist, attending by preference to molluscs and, like Mr. Jordan, to fishes. Whilst dwelling in Sicily, from 1805 to 1815, he is said to have "discovered the medicinal squill," in which he did a large business. Unless we are much misinformed, the squill was in use during the last century. He formed the acquaintance of W. Swainson, the quinarian, and of Audubon. He collected and described shells, and fishes, and plants from the Hellespont to the Wabash. His scientific work was vitiated by neglect of details and by his lack of specialism. He attempted work in every held of learning, and the result was what we might expect. He was, however, one of the earliest botanists who rebelled against the artificial groupings of Linnæus, foreshadowing Jussien, and he had even an inkling of organic evolution. But for his views he reaped merely hatred and contempt, being spoken of by his neighbours as a "crazy herb-doctor." He died in poverty and neglect, and the very place of his burial is forgotten.

The paper on Darwin is genial, appreciative—we may even say, loving. But we meet with a strange mistake at the close.

Mr. Jordan writes:—"Among all who have written or spoken since then (Darwin's burial), whatever their religious faith, by none has an unkind word been said." Alas! we know to the contrary. The harpies of classical legend have left behind them legitimate descendants.

An "Ascent of the Matterhorn" is an account of danger and trial undergone for nothing. The Alps are played out. The same amount of peril and fatigue in the Andes or the Himalaya would have been remunerative.

Turning Lathes: a Manual for Technical Schools and Apprentices. Edited by James Tukin, B.A. London: E. and F. N. Spon. Price 3s.

We cannot say that we think there is any necessity for this little book on elementary turning, as the subject has been repeatedly covered in a similar manner by equally upretending little volumes, but the humility of the preface disarms criticism, and if, as the editor hopes, there is room for another treatise on the subject, we think an absolute novice is as likely to learn as much of the rudiments of turning from this book as from those already published.

NOTES ON METEORITES.

DR. REUSH (*American Naturalist*), discussing the phenomena connected with the fall of these bodies, says that the velocity of the fire-ball seen in the sky has been ascertained to be from 40 to 45 miles per second. This tremendous speed accounts for the fire phenomenon, as the atmosphere not being able to escape in front of the stone, becomes condensed to an enormous degree—a great quantity of heat becoming thus developed according to known physical laws. The meteorites at one time having the temperature of space through which they were rushing—a temperature far below the freezing-point—will thus become enormously heated on the outside when entering the earth's atmosphere. The pressure of the strongly-condensed atmosphere finally exceeding a certain limit, acts as a blasting agency, according to a commonly-received opinion, and the fire-ball explodes. The fragments are still glowing for a while after the explosion, but as a rule they have probably become cooled on reaching the ground. Nor is the final speed very considerable, the original velocity of the fire-ball having been diminished by the resistance of the air.

When falling at full speed the surface of the meteorites may be supposed to be continually melting, nay, perhaps evaporating. By the friction of the air, however, the molten substance is removed almost as fast as it is formed. In this way may be explained the "fire-tail" which the observers in many cases affirm that they have seen. In the same manner is formed the smoke which on several occasions has been observed floating in the wake of the fire-ball.

BACTERIOLOGY.—The Dutch Government has resolved upon establishing a bacteriological institution at Batavia, in Java.

Abstracts of Papers, Lectures, etc.

GEOLOGICAL SOCIETY OF LONDON.

At the meeting held on April 25th, 1888, Mr. W. T. Blanford, LL.D., F.R.S., President, in the chair, the following communications were read:—

"Report on the Recent work of the Geological Survey in the North-west Highlands of Scotland, based on the field-notes and maps of Messrs. Peach, Horne, Gunn, Clough, Hinxman, and Cadell." Communicated by A. Geikie, LL.D., F.R.S., F.G.S., Director-General.

At the outset a review was given of the researches of other observers, in so far as they forestalled the conclusions to which the geological survey had been led. Reference was made to the observations of Macculloch, Hay, Cunningham, C. W. Peach, and Salter; to the prolonged controversy between Sir Roderick Murchison and Professor Nicol; to the contributions of Hicks, Bonney, Hudleston, Callaway, Lapworth, Teall, and others. It was shown that Nicol was undoubtedly right in maintaining that there was no conformable sequence from the fossiliferous quartzites and limestones into the eastern schists. It was also pointed out that the conclusions of Professor Lapworth regarding the nature and origin of the eastern schists involve an important departure from Nicol's position, and are practically identical with those obtained independently by the Geological Survey.

The results of the recent survey work among the Archæan rocks may be thus summarised:—(1) the eruption of a series of igneous rocks of a basic type in which pegmatites were formed; (2) the development of rude foliation in these masses, probably by mechanical movement, and their arrangement in gentle anticlines and synclines, the axes of which generally run N.E. and S.W.; (3) the injection of igneous materials, mainly in the form of dykes, into the original gneisses, composed of (*a*) basalt rocks, (*b*) peridotites and palæopicrites, (*c*) microline-mica rocks, (*d*) granites; (4) the occurrence of mechanical movements giving rise to disruption-lines trending N.W. and S.E., E. and W., N.E. and S.W.; (5) the effects of these movements on the dykes were to change the basalt-rocks into diorites and hornblende-schists, the peridotites and palæopicrites into talcose schists, the microcline-mica rocks into mica-schists, and the granites into granitoid gneiss; (6) the effects on the gneiss resulted in the formation of sharp folds trending generally N.W. and S.E., the partial or complete reconstruction of the original gneiss along the old foliation-planes, and finally the development of newer schistosity more or less parallel with the prominent disruption-lines.

There is an overwhelming amount of evidence to prove that all these various changes had been superinduced in the Archæan rocks in Pre-Cambrian time.

After reviewing the facts bearing on the denudation of the Archæan land-surface, the order of succession and thickness of the Cambrian strata were given, from which it is apparent that the deposits gradually increase in thickness as we pass southwards from Durness to Loch Broom.

Prior to the deposition of the Silurian sediments the Cambrian strata were folded and extensively denuded. By these means various Cambrian outliers were formed far to the east of the present limits of the formation.

The order of succession of the Silurian strata along the line of complicated structure from Eriboll to Ullapool was described, reference being made to the further subdivision of the "Pipe-rock" and the Ghrudaidh Limestones (Group I. of Durness section). None of the richly fossiliferous zones of Durness is met with along this line, as they occupy higher horizons. An examination of the fossils recently obtained by the Geological Survey from the Durness Limestones confirms Salter's conclusions that they are distinctly of an American type, the Sutherland quartzites and limestones being represented by the Potsdam Sandstones and Calciferous Sand Group of North America.

After a deposition of the limestones, the Cambrian and Silurian strata were pierced by igneous rocks, mainly in the form of sheets, producing important alterations in the sedimentary deposits by contact-metamorphism, the quartzites becoming crystalline, and the limestones being converted into marble.

When this outburst of volcanic activity had ceased, terrestrial displacements ensued on a stupendous scale. By means of powerful thrusts the Silurian strata were piled on each other, and huge slices of the old Archæan platform, with the Cambrian and Silurian strata resting on it, were driven westwards for miles. With the view of illustrating the extraordinary complications produced by these movements, a series of horizontal sections was described drawn across the line between Eriboll and Ullapool.

The evidence relating to regional metamorphism was next referred to, from which it is obvious that with each successive maximum there is a progressive amount of alteration in the displaced masses, as the observer passes eastwards to the higher thrust-planes. Eventually the Archæan gneiss is so deformed that the Pre-Cambrian foliation disappears and is replaced by new divisional planes; the Cambrian grits and shales are converted into schists; the Silurian quartzites into quartz-schists; the limestones become crystalline; the sheets of intrusive felsite, diorite, and granitoid rock pass into sericite schist, hornblende-schist, and augen-gneiss respectively.

The researches furnish a vast amount of evidence in support of the theory that regional metamorphism is due to the dynamical and chemical effects of mechanical movement acting on crystalline and elastic rocks. It is also clear that regional metamorphism need not be confined to any particular geological period, because in the N.W. Highlands, both in Pre-Cambrian time and after the deposition of the Durness Limestone (Lower Silurian), crystalline schists and gneiss were produced on a magnificent scale.

"On the Horizontal Movements of Rocks, and the relation of these movements to the formation of Dykes and Faults and to denudation and the thickening of Strata." By William Barlow, Esq., F.G.S.

The paper commenced with a description of some horizontal movements of rocks caused by gravitation; and the author quoted Mr. C. E. Dutton's descriptions of the Grand Cañon District, especially noting the fact that between succeeding escarpments the strata dip slightly from the crest of the one below to the foot of the next above, and that whilst the strata of the median parts of each terrace are nearly horizontal, the inclination increases as we approach the escarpment of the next higher terrace, and also that Dutton observed indications of a

slight elevation of the unloaded strata within the denuded elliptical area known as the "San Rafael Swell." After alluding to Dutton's suggestions that the phenomenon referred to is analogous to the action of creeping in deep mines, the author discussed the nature of such "creeps," which he defined as the thickening of the parts of beds from which a load of superincumbent rock has been lifted, caused by a thinning of the adjoining parts which remained loaded, some of the substance of the latter having been squeezed out to furnish the material for the thickening, and suggested that some of the subsidiary plications found on the flanks of mountains are caused by the thrusts arising from creeps. He also paralleled the fissures in the precipices of the Grand Cañon District with those produced in the pillars of coal owing to the strain induced by the slight inequality in the yielding of the bed supporting it, and pointed out how such fissures would facilitate denudation, giving instances recorded by Dutton, and that an appreciable influence might be thus produced in all cases of mountain-denudation.

The author next considered the case of a body of molten rock below a considerable mass of solid rock. The pressure upon the molten mass would cause movement to take place towards the point where the superincumbent weight was least, provided that absolute equilibrium did not exist. The overlying rocks being more or less plastic, some horizontal movement of the solid rocks at the confines of the molten mass, and subjected to its influence, might be looked for. Any such yielding would tend to draw apart the solid crust resting upon the molten rock, and the ground would open along lines of weakness, such as would be produced by the presence of joints, the crust in some cases breaking up into larger or smaller fragments.

When a large mass of molten matter occurred near the surface, and a fissure was produced in the way described, the weight of the ruptured crust would, if the plastic mass beneath were sufficiently liquid, cause the latter to rise in the fissure, producing dykes. Attention was called to the fact observed by Dutton that basaltic vents frequently occur on the brink of cliffs, but never at their bases; also to the existence of dykes having a strike parallel to the Colorado River. In most cases the vertical fissures which received the molten rock would begin to open from below, and the upper strata might altogether escape rupture.

The author discussed the case of the Henry Mountains, and explained the formation of flat-topped and flat-bottomed dykes according to his views. He next called attention to the influence which the motions of the rocks had exercised in determining directions of drainage when fissures left unfilled became occupied by streams. He next alluded to river-valleys, the existence of which had been accounted for by "antecedent" and "superimposed" drainage, and suggested difficulties in the way of accepting the explanations hitherto advanced, and considered them to be instances of fissuring produced by movements of the strata due to the pressure of a mass of molten or highly plastic rock spreading laterally.

After treating of the formation of faults with normal hade, which he referred in some cases to rupture of the solid crust by the spread of a vast mass of viscous matter lying beneath it (the faults being sometimes replaced above by monoclinal folds), he referred, in conclusion, to the extent of the horizontal compression of the earth's superficial crust which is seen to be associated with the elevation of mountain-ranges, and called attention to some evidence that the thickening of the strata caused thereby would be more considerable and general than ordinarily supposed.

"Notes on a Recent Discovery of *Stigmaria ficoides* at Clayton, Yorkshire." By Samuel A. Adamson, Esq., F.G.S.

The specimen described was obtained in November, 1887, from the beds between the Better-bed Coal and the Elland Flagstone of the Fall-top Quarries of Messrs. Murgatroyd. The author gave measurements of the specimen, and compared them with those of another found in the same quarry in 1886, and now preserved in the Owens College, and with those of a third obtained in an adjoining quarry.

ROYAL HORTICULTURAL SOCIETY.

At the meeting of the Scientific Committee held on April 24th, Mr. Burbidge gave the following further particulars about the remarkable form of fringed daffodil described at the last meeting. He said that there existed but a single clump in the lawn of Rev. Mr. Gabbet, Croom Rectory, Co. Limerick. The flowers had come true for several years. It was associated with *N. spurius* and *N. Telemonius* (*plenus*), the former seeding itself. It appears to be a sport from *N. spurius*, but nothing certain is known of its actual origin.

Specimens of the not uncommon phenomenon, self-mutilation of hyacinths, were sent from Colonel Urquhart, of Rosebay, Broughty Ferry, for information as to the cause. The spikes have the appearance of being pinched off when first emerging from the bulb. The cause is apparently twofold; on the one hand, the bud-scales at the top are too rigid, while on the other the spike was well nourished; the result being, that the insufficient expansion of the scales checked the development of the spike at the place where it becomes decapitated. The probable explanation was the excessively fine season of 1887, the "ripening off" bringing about the rigidity of the bulb-scales, at the same time favouring the formation of the spike within. Mr. Burbidge observed that it is a noticeable fact that the Chinese gash their bulbs with three slits at the top, to allow of the free escape of the spike, and to prevent such constrictions.

On a further examination of the hazel catkins brought to the last meeting by Dr. Masters from Mr. Syme, Mr. Henslow observed that, besides bearing female catkins at the base of the male, the latter were proliferous, the basal branches being covered with staminate flowers resembling the so-called "Egyptian Wheat," a variety of Revett's, on which several of the spikelets grow out into ears; so that five or more may proceed from one stalk. These two peculiarities—the proliferous state of the male catkins and the presence of female ones—corroborated the conclusion arrived at by Mr. Meehan, of Philadelphia, who observed in various declinous trees, that the female flowers were always associated with a relatively greater degree of vigour; or conversely, that an increased vigour produced female flowers, when normally nothing but male would have appeared.

Dr. Masters received a communication from M. Naudin, in which he speaks of the hardiness of *Ecalyputus urnigera* at Brest and elsewhere, where it is subject to occasional severe frosts. He says that *E. coccifera* will compare favourably with it, as also *E. viminalis* (falsely called *E. amygdalina*), which is nearly as hardy. The last severe

winter has shown the different degrees of hardiness among the various species of eucalyptus. He adds that a considerable number, even of very young trees, were absolutely insensible to the frost, while others, much larger and older, have had their foliage more or less damaged. Even *E. globulus*, usually so hardy, has had some of its leaves frozen, principally through the melting of the snow by the sun's heat. Mr. Burbidge remarked on the general presence of bloom or wax on the young leaves, and its absence on the older—probably a provision against too great transpiration in the young state. Mr. Henslow offered a similar interpretation of the scimitar-form of the older leaves to that of the obliquity of pears and fir cones. When the stalk stands at an angle with the vertical, the weight of the leaf acting vertically downwards, the tension being along the stalk, the leaf consequently grows much more on the outer side to meet the strain of the resultant of these two forces—the vertical position, as of that of the stipules of acacia, being probably adaptations to avoid too great radiation in the dry climate of Australia.

ROYAL SCOTTISH SOCIETY OF ARTS.

At the meeting held on April 23rd, Dr. F. B. Imlach, President, in the chair, Mr. J. N. Inglis, C.E., read a paper on "Plantations Producing Fuel and Timber for Building Purposes in Bengal and Burmah." He remarked that so great was the demand for wood for building purposes in Bengal that in the last quarter of a century trees seldom arrived at maturity before the axe was laid upon them, and large tracts of the country in the vicinity of the railway and inhabited parts were bare of trees. Trees and shrubs were now planted round every village. Famine, which was unknown in former years, was becoming a painful reality; but if a country was sufficiently wooded, it was almost certain to obtain the requisite rainfall. Referring to the plantations on the banks of the canals in Burmah, Mr. Inglis said that the cost of planting a tree and bringing it to maturity was about 15s., and that it was sold by the Government, to be used for building purposes, at about £5. The President read two papers by Mr. R. Norman Shaw, R.A., on "Patent Drains," and on "A System of House Drainage by Open instead of Closed Soilpipes." Mr. D. William Kemp contributed a paper regarding "Improvements in Shaping Ductile Metals to form Concave, Indented, or Hollow Articles, by the Direct Application of Fluid Pressure."

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

At the meeting of this Society on April 26th, the President, Mr. Billerps, exhibited a gigantic *Blatta*, accidentally imported alive in a case of orchids from South America.

Mr. J. W. Slater, F.E.S., read a paper on "Nature's Sanitary and Anti-Sanitary Services," showing that whilst certain living beings were actively engaged in removing and destroying offensive matters, others are no less diligent in spreading the germs of putrefaction and disease. He further pointed out that the examination of this subject supplies important evidence in favour of the doctrine of organic evolution.

ROYAL BOTANIC SOCIETY.

At a meeting of this Society held last Saturday, Mr. J. P. Gassiot, Vice-President, in the chair, a large number of interesting donations of plants and seeds was reported, including seeds of the "Flowering Fence" of the tropics, collected by Commander Izat, R.N., in Loanda, Africa, and a number of Tillandsias or air plants from Brazil, presented by Mr. J. P. Gassiot.

FORAMINIFERA.—III.

(Concluded from page 414.)

THE study of fossil forms of the Foraminifera is one of great interest on account of the variation, and also of the persistence, of form through succession of time that is exemplified by them. It will be well to remember that regarding external form, the so-called species of foraminiferal shells are seen to have very doubtful claim to a specific name when compared with the same distinctions in other groups, these specific names being recognised as such merely for convenience, the distance of variation from one form to another being scarcely perceptible.

In gatherings of the recent forms there is often a predominance of the Porcellaneous type of Foraminifera, such as the British forms *Miliolina seminulum* (fig. 5), *M. oblonga*, and *Biloculina ringens* (fig. 3). Again, in contrast with this, these shells are rare or altogether absent from fossil deposits. In reference to this it has recently been shown that as the mineral substance of this Porcellaneous type consists of Aragonite, the unstable form of carbonate of lime, most probably these forms, though perhaps having existed in the periods to which these fossil deposits are referable in as large a preponderance as at the present day, may have been subsequently removed by dissolution, leaving only those shells behind which had invested themselves with the mineral form Calcite.

As it is advisable to compare fossil forms with recent ones we will here describe the method of separating these minute organisms from clays. It is requisite at the outset to dry the material thoroughly, breaking it up into pieces of about an inch cube. These pieces are dropped into water, and, after a short time, when the fragments have disintegrated to a mud, the mass must be shaken, allowed to subside, and the muddy water poured off. Great care, however, should be taken to prevent any escape of shells like *Lagena*, which from their flask shape will probably remain floating much longer than other more solid forms of the same minuteness. As a safeguard against the loss of some of the most important forms, the mud may be decanted through the finest muslin; but generally it will be found that a sufficient number will have settled with the finest part of the residue, which, to facilitate sorting, should be sifted into the various finenesses when dried. During the cleansing of the residue from mud it is needful to have a minimum supply of water to agitate it in, as the particles have then a chance to lightly touch against one another, and thereby aid the separation of mud from the shells.

In working upon fossil deposits for Foraminifera one may find instances which show how wonderfully these minute bodies can be preserved against great local movements. In one instance, for example, there was a clay crowded with fossils both large and small, wherein could be traced the crushing influence that had borne down upon the stratum, and the effects produced upon the contained fossils noted. The Foraminifera and ostracod valves, with their surface decorations of delicate spines, tubercles, and corrugations, were intact, but, beginning with small gasteropods, all else of a larger size had been

more or less flattened. Too coarse was the disturbing influence to interfere with the shells that were—

> " Slight, to be crushed with a tap
> Of my finger-nail on the sand ;
> Small, but a work divine ;
> Frail, but of force to withstand,
> Year upon year, the shock
> Of cataract seas that snap
> The three-decker's oaken spine . . . "

Having procured specimens of the Foraminifera we may require to examine the shells by transmitted light under the microscope in order to ascertain their structural characters, when thin sections must in most cases be made ; although in a few instances the shell is thin and small enough to allow of high powers being used, as in *Uvigerina* (fig. 15), which is transparent enough for microscopic examination when mounted in Canada balsam. Again, for some specimens it will not be necessary to cut away more than half the shell, as, for instance, if we wish to examine the arrangement in those forms where the outer chambers embrace the inner ones, as in *Miliolina* (fig. 5). Where however the shell has to be sliced, we place upon the hot plate of our mounting table, which may consist of a brass plate supported on a tripod beneath which burns a spirit lamp, a piece of glass of the size of half an ordinary microscopic slide, dropping a little balsam on the surface, and heating the glass gently. When the balsam has been warmed to the condition of toughness when cold, a small piece of mica is placed upon the still liquid balsam on the glass plate, pressed down and another drop of balsam placed on the mica. During the heating of this last application of balsam the shells are placed on the mica, when they proceed to sink into the balsam as they are warmed. It is a good plan to have three shells arranged in a triangle on each plate, as this facilitates equal grinding. The object of gradual heating is that the shells may be thoroughly permeated by the balsam, and their chamber-walls consequently protected if they be thin. When the plate thus prepared has cooled, the balsam should be just tough or unimpressible to the finger-nail. Taking an even-textured piece of snakestone—that is, one in which the spots are evenly distributed throughout—a clean cutting surface may be produced upon it by grinding on a piece of plate glass with some emery of a kind slightly coarser than that of " flour." The surface of the stone must of course be thoroughly cleansed from any trace of emery, when the glass slip with the shells should be rubbed upon it very gently at first, with a circular motion, now and again examining them with a lens, until just about half of each shell remains. It will be found that a few rubs on the stone will generally suffice for the ordinary-sized Foraminifera, so that extreme care must be taken throughout the process. Again placing our slip on the hot plate, after having carefully dried it, we put beside it a mounting slip which we touch in the centre with a little balsam, and allow it to harden down. By the time this latter is prepared we can remove with forceps the mica bearing the shells, with their upper halves ground away, from the first plate, and turning the film over with the shells beneath we let it fall inclined, to exclude air, on to the second slip. When cold the mica may be removed by inserting a knife point under one corner, and the second grinding proceeded with. The sections, after having been ground upon the stone with water until the requisite thinness has been attained, are mounted as transparent objects in balsam. It will be found during the second grinding that the balsam will resist the progress to some extent, but this may be overcome by chipping it away as near to the shells as can be done with safety. If sections showing only internal arrangement are required, as in fig. 9, after the half of the shell has been removed, the specimens, to be cleaned from the balsam, may be left for some time in absolute alcohol, taken out, and dried.

In conclusion, it may be remarked that though the study of this group of animal remains is hampered by synonyms, yet the knowledge regarding them is distinctly approaching something like order, and less like the primitive undigested heap of biology alluded to by one writer on the subject. Moreover, the knowledge can only be extended by careful and accurate observations, and any who are interested in the study of these minute forms of life can add something to the general fund.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

TUBERCULOSIS FROM THE USE OF MILK.

In the *Chemiker Zeitung* for April 8th (p. 477) we read:—" The death of a child aged four months from tuberculosis was traced by Prof. Demme, of Bern, to the use of the unboiled milk of diseased cows." The danger of the use of such milk, though often denied, thus receives fresh confirmation.

ZERO.

RESTS FOR AMPHIBIA IN AQUARIA.

I have often observed that the feet of newts, frogs, and other amphibia kept in aquariums are rendered sore by endeavouring to scramble up the rough stones often placed to serve them as resting-places. I have found it better to put in the aquarium stout pieces of flat cork, of a suitable size, which may be kept in a suitable position by moorings of iron wire, fixed to rock-work beneath the surface.

RANA.

THE NEW "SHELL-COLLECTORS' HANDBOOK."

Since the author of the "Shell-collectors' Handbook for the Field" (Roper and Drowley) has replied to the criticisms contained in your review of his book, and since a great number of your readers are doubtless interested in shell-collecting, I think a few additional remarks on the subject may, perhaps, be acceptable. In your review it was, I think, made clear that the present Handbook is calculated to be of great use, and it certainly contains a fuller collection of varietal names and descriptions than any other book which has yet been written for the use of British conchologists, and, as no desire was shown to find fault, only a very few examples from the numerous errors and omissions which a perusal had discovered were mentioned. Many more of these, however, have since been pointed out in a careful review in the *Naturalist*, from the pen of the Conchological Society's recorder, and it is now only necessary to reply to the points mentioned in the author's letter. In reply to a remark, which was to the effect that the book contained no notes on habits and distribution, and that such need hardly have been omitted for the purpose of keeping the volume within pocket-size, it is stated that "conchology is essentially a field, and not a home, study"; but most people, it is believed, while they collect in the field, retire to their homes to study their finds. There are numerous omissions which the statement in the latter part of the preface, that the varieties described are "those which have been verified by the Council of the Conchological Society or by the author,"

can hardly cover. For instance, the var. *plumbea* of *Arion ater* was described by Mr. Roebuck, himself the recorder for the Conchological Society, than whom, probably, no one has examined a greater number of living slugs. It is imagined that the remark, "var. *plumbea* is but a pale, and perhaps a young, type," is made without a sufficient knowledge of variation. Full descriptions of varieties, named evidently without sufficient study, are omitted not unwisely; but, unfortunately, that which has once been published cannot be altogether ignored, and, therefore, varieties considered worthless, should, it is thought, have had a passing mention. It is surprising that the scoop should be regarded by Dr. Williams as "new fangled," for it has been in use now for many years. It is recommended in Rimmer and other shell-books.

YOUR REVIEWER.

UNIVERSITY OF LONDON.—The following gentlemen have been elected Examiners for 1888-89:—

Latin.—Prof. R. Y. Tyrrell, D.Lit., LL.D., M.A., and Prof. A. S. Wilkins, Litt.D., LL.D., M.A.

Greek.—Rev. H. A. Holden, LL.D., M.A., and Rev. William Wayte, M.A.

The English Language, Literature, and History.—Prof. Edward Arber, F.S.A., and Mr. Henry Craik, C.B., LL.D., M.A.

The French Language and Literature.—Rev. P. H. E. Brette, B.D., B.A., and Mr. Amédée Esclangon.

The German Language and Literature.—Prof. C. A. Buchheim, Ph.D., and Mr. Herman Hager, Ph.D.

The Hebrew Text of the Old Testament, the Greek Text of the New Testament, the Evidences of the Christian Religion, and Scripture History.—Mr. G. J. Spurrell, M.A., and Rev. C. H. H. Wright, D.D., Ph.D., M.A.

Mental and Moral Science.—Prof. Robert Adamson, LL.D., M.A., and Rev. Prof. William Knight, LL.D.

Political Economy.—Prof. C. F. Bastable, M.A., and Prof. J. S. Nicholson, D.Sc., M.A.

Mathematics and Natural Philosophy.—Prof. M. J. M. Hill, M.A., and Mr. Joseph Larmor, D.Sc., M.A.

Experimental Philosophy.—Prof. G. F. FitzGerald, M.A., F.R.S., and Mr. R. T. Glazebrook, M.A., F.R.S.

Chemistry.—Prof. J. Emerson Reynolds, M.D., F.R.S., and Prof. W. A. Tilden. D.Sc., F.R.S.

Botany and Vegetable Physiology.—Prof. F. Orpen Bower, D.Sc., M.A., and Prof. H. M. Ward, M.A.

Comparative Anatomy and Zoology.—Prof. E. Ray Lankester, M.A., F.R.S., and Mr. Adam Sedgwick, M.A., F.R.S.

Geology and Palæontology.—Rev. Prof. T. G. Bonney, D.Sc., F.R.S., and Prof. W. Boyd Dawkins, M.A., F.R.S.

Jurisprudence, Roman Law, Principles of Legislation and International Law.—Prof. E. C. Clark, LL.D., M.A., and Mr. J. B. Moyle, M.A., B.C.L.

Equity and Real and Personal Property.—Mr. Leonard Field, B.A., and Mr. R. Horton Smith, M.A., Q.C.

Common Law and Law and Principles of Evidence.—Mr. Lindsey M. Aspland, LL.D., M.A., Q.C., and Mr. Lumley Smith, M.A., Q.C.

Constitutional History of England.—Mr. Henry E. Malden, M.A., and Prof. T. E. Scrutton, M.A., LL.B.

Practice of Medicine.—Mr. William Cayley, M.D., and Prof. F. T. Roberts, M.D., B.Sc.

Surgery.—Mr. W. Morrant Baker and Prof. Christopher Heath.

Anatomy.—Prof. John Curnow, M.D., and Prof. Alexander Macalister, M.D., M.A., F.R.S.

Physiology.—Mr. J. N. Langley, M.A., F.R.S., and Prof. E. A. Schäfer, F.R.S.

Obstetric Medicine.—Mr. F. H. Champneys, M.A., M.B., and Prof. John Williams, M.D.

Materia Medica and Pharmaceutical Chemistry.—Mr. J. Mitchell Bruce, M.D., M.A., and Mr. Frederick Taylor, M.D.

Forensic Medicine.—Prof. G. V. Poore, M.D., B.S., and Mr. Thomas Stevenson, M.D.

Music.—Mr. William Pole, Mus.Doc., F.R.S., and Mr. John Stainer, Mus.Doc., M.A.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

WEEDING TOOL.—A tool for weeding purpose has been patented by Mr. W. G. Thompson, on behalf of A. G. Compton, United States. This tool is specially intended for use on lawns, etc. A spike is placed upon the weed, and a pivotted knife is then made to undercut the roots by pressure applied by the foot to a lever, the knife is brought back to its original position by a spring.

TELEPHONE.—Messrs. D. H. Smith, of Glasgow, and H. F. Jackson, of London, have patented an improvement in telephones. This consists essentially in the combination with telephonic instruments of a counting device operated by the calling-button or equivalent device, and an arrangement by which when the calling-button is moved an indication is given to the operator at the exchange that the instruments have been used, simultaneously with the making by the counter of a record of such use for future reference.

LIFEBOAT.—Mr. J. A. Aniello, United States, has patented a lifeboat. The object of this invention is to construct a lifeboat which cannot be capsized, cannot sink, and out of which the passengers cannot be washed by the waves. The boat consists of two air and water-tight side chambers or compartments, and a similar central compartment, a grated flooring being arranged above the central compartment and between the side compartments, while compartments adapted to receive the passengers are provided in the bow and stern ends of the boat.

TELEPHONE.—Mr. W. J. Morton has patented a telephone. A steel diaphragm is employed with a coil held in a recess of the frame, a mouthpiece, and binding screws. No core is used, but the diaphragm is permanently magnetized, preferably to the so-called "neutral" state; so that its molecular vibrations, produced by the impact of sound waves, set up currents in the coil held in the recess in the frame. In some cases the magnetized diaphragm is held within an annular steel magnet.

DRYING DAMP BOOTS.—Mr. E. W. Stead has patented an apparatus for drying damp boots. The invention consists of a hollow stoneware last of a shape corresponding to the inside of ordinary boots and shoes. At the top it extends a few inches higher than ordinary walking boots for convenience of inserting and withdrawing the last from the boot. The cavity at the top of the last is of a conical shape and leads to the central inlet hole. To dry the boot the last is filled with hot water, and then stoppered up tightly. The heat given off by the last dries the boot within which it is placed without damaging the leather, as would be done by drying in front of a stove.

ELECTRIC LAMP.—Mr. M. Wheeler, of Canada, has patented an incandescent electric lamp. Its object is to obtain a greater degree of heat, and consequently a greater incandescence at a given point The invention

consists of a suitable holder which is filled with an amorphous mass of zirconia, with a number of pairs of carbons, which extend into the holder, and around the points of which the zirconia is packed, each pair of carbons being connected to opposite poles of a suitable battery, whereby the currents of electricity are made to flow in opposite directions, meeting and passing each other at a common centre.

Safety Guard for Windows.—Mr. T. Miller has patented a safety guard for use in cleaning windows. The invention consists of two bent metal bolts of convenient size, one of each being inserted in the vertical stones forming the side of the window at an angle, to give greater stability. The bolts at their projecting ends are in a vertical position to enter an eye in a flexible steel band. The ends of this band are folded over and firmly rivetted, thus forming the eye for the ends of the bolt to enter. Near the top of the projecting part of the bolt is a hole made to receive a split pin, which is secured to the band by a chain, to prevent the band from slipping off the supporting bolt. This band, stretched across the window, prevents a person falling backwards to the ground.

Fare-Indicating Apparatus.—Mr. W. F. Nedler, Germany, has patented a fare-indicating apparatus for cabs. This invention comprises an improved arrangement of the dial plate, upon which the fare to be paid for each hiring is indicated in order that when the hand of the indicator has passed around the whole or part of the circumference of the dial, a number corresponding to the distance passed through presents itself opposite an opening, and serves for the calculation of the fare, independently of the motion of the indicating hand and mechanism for presenting these numbers opposite the said opening. The invention also comprises means for indicating upon the dial the minimum fare which must be paid for hire, no matter whether the corresponding distance or duration of time has been attained or not.

Stirrup.—A safety stirrup has been patented by J. Williams, Walsall. According to this invention a secondary bow is pivoted at its lower end on each side to the inside of an ordinary stirrup bow. The sides of the secondary bow are carried up for some distance inside the ordinary bow, and are curved out a little backwards as they round over to meet one another to complete the top of the bow, so as to bring the rounded top of the secondary bow immediately behind the corresponding top of the ordinary bow. A forwardly projecting stud is fixed to the top of the secondary bow, and closes into a corresponding opening in the top of the ordinary bow as the secondary bow is pushed up against the ordinary bow. A metal loop is carried by the stirrup leather, and the stirrup is connected with such link by passing the stud therethrough, and closing in the secondary bow with the link between the secondary and ordinary bows. In use the weight of the stirrup and also the pressure of the rider's foot on the tread, tends to keep the bows closed, but it through any cause the foot of the rider be turned back in relation to the stirrup, the sides of the foot will press backwards against the sides of the secondary bow, and thus open out such bow from the ordinary bow and release the stirrup from the link carried by the leather.

TECHNICAL EDUCATION NOTES.

The Polytechnic Institution.—Sir Lyon Playfair, in distributing the prizes at this institution on April 27th, said that, in order to make the Institution permanent, the Charity Commissioners had promised to endow them on the condition that they raised a considerable quantity of money, and there was still something like £18,000 wanting. The total sum required was about £36,000. He trusted that the members of the Institute would themselves substantially help towards collecting this amount; and that as a result of their meeting considerable subscriptions might come in to found the institution permanently and make it an example to the world and to the country. Formerly—and he was afraid at the present time—working-men were classed as hands, not as heads; but the times were now changed, and the competition of the world had become a competition of intellect. It was science which had altered so much the whole of industry; it was because the world had not got itself yet adapted to the wonderful scientific inventions which had taken place since 1874 that that they had so long a period of depression in trade. It was a recognised truism now that the competition of the world had become a competition of intellect, but it was not yet a truism that the education which was to draw out the intellect of working-men must suit the several localities and the several trades. In conclusion, the speaker said he trusted they would do their utmost to make their institution not only permanent, but an ornament and a model to the other institutions in the country.

Technical Instruction for South-west London.—Mr. Anstie, Q.C., received at the Charity Commissioners' offices, Whitehall, on April 30th, a large deputation from Chelsea, Pimlico, St. George's, Hanover Square, and Fulham, who asked for a grant of money from the City Parochial Funds, in order to establish a technical institution in the south-west of London. The deputation included Lord Monkswell, Sir C. Dilke, Colonel Howard Vincent, M.P., Mr. Whitmore, M.P., Hon. S. Holland, Sir A. Hayter, Mr. Antrobus, the Rev. F. Relton, the Rev. G. Blunt (rector of Chelsea), and the Rev. Prebendary Eyton (rector of Upper Chelsea). The Rev. F. Relton, in introducing the subject, said Earl Cadogan had offered a site upon which to erect the institution, and had left it to them to choose a suitable one. The site would cost £2,500, but Earl Cadogan had said that if they acquired the leasehold he would give them the freehold. There had been for about twenty years a small technical institution, which had resulted in the formation of Onslow College, the success of which had been very great. They were anxious that in the south-west of London there should be a technical institution such as was proposed for the north of London, the south of London, and the east of London. He could assure the Commissioners that there was a great deal of poverty in the south-west of London, and he might add that there was a large number of artisan dwellings in the locality—a fact which fully entitled then to a share of the funds. Mr. Antrobus, speaking on behalf of St. George's, Hanover Square, said the great advantage to be derived from the establishment of such an institution in the south-west of London was generally recognised. Mr. Anstie, in reply, said he could not give the deputation any definite answer; but if the locality could raise the sum of £50,000 and could come to some agreement with Onslow College, the Commissioners would give the proposal their consideration.

The Royal Victoria Hall.—On April 25th a meeting of the friends and supporters of this institution was held at Grosvenor House, the Duke of Westminster occupying the chair. In opening the proceedings, the Chairman said that was a crisis in the history of the Victoria Hall. The institution had been increasingly successful in its many departments, and now it had been contemplated by the Charity Commissioners that with the funds with which they had to deal three institutions of a similar character should be established in South London. It had been practically arranged that the hall should be taken over by the Charity Commissioners, if the trustees could make arrangements to buy up the freehold. The freehold would cost £17,000, and it was desired to raise that sum in order to make the purchase.

ANNOUNCEMENTS.

MARINE BIOLOGICAL ASSOCIATION.—The Council of the Marine Biological Association of the United Kingdom have appointed Mr. Gilbert C. Bourne, Fellow of New College, Oxford, to be Secretary of the Association, and Director of the Plymouth laboratory.

CAMBRIDGE.—Mr. H. Marshall Ward, of Christ's College, was appointed an examiner in botany for the Natural Sciences Tripos, the first examination for the degree of M.B., and the special examination in botany for the ordinary B.A. degree. Mr. T. C. Fitzpatrick, B.A., of Christ's College, has been appointed an assistant demonstrator in physics.

ATHENS NATIONAL EXHIBITION.—The Board of Trade have received through the Foreign Office a despatch from Her Majesty's Minister at Athens reporting that the time for receiving applications for admission from intending exhibitors at the Athens National Exhibition, to be held in the month of October next, has been prolonged until the 13th inst.

THE BRITISH ASSOCIATION.—The public lecturers for the Bath meeting of the British Association have just been appointed. On Friday, September 7, Professor W. E. Ayrton will lecture on the "Electrical Transmission of Power;" on Monday, September 10, Professor T. G. Bonney will lecture on the "Foundation Stones of the Earth's Crust;" and the lecture to the operative classes, on Saturday, September 8, will be by Sir John Lubbock, who has chosen as his subject, "The Habits of Ants."

HAILEYBURY COLLEGE.—The following scholarships have been awarded:—Senior Scholarships—Classical side. E. C. Cunningham, £48; F. K. Boyd, C. W. Hensley, and H. G. Rivington, equal, £33. Modern side—H. W. C. Bowdoin, £33. Junior Scholarships.—Classical side (under 14 years).—W. Outram, A. F. Henderson. Modern side.—M. C. Blandy. Classical side (under 13 years.—B. Fisher. These are of the value of £30 for three years. R. Couchman, an additional scholarship of £20, with nomination for two years.

ROYAL AGRICULTURAL SOCIETY.—We are authorised to announce that Her Majesty the Queen has been graciously pleased to signify her acceptance of the office of President of the Royal Agricultural Society of England during its forthcoming jubilee year. His Royal Highness the Prince of Wales, to whom the Society is already so greatly beholden, and who has himself served as President on three separate occasions, has intimated to the Council his willingness to undertake, on Her Majesty's behalf, the more immediate duties of the presidential office. The annual country meeting will be held next year, with Her Majesty's gracious permission, in a portion of Windsor Great Park set apart for the purpose.

HAMPSHIRE FIELD CLUB.—This Society numbers about 170 members, and from the reports of its annual meeting it seems to be in a prosperous condition. For the ensuing session the following papers of a scientific character have been arranged—"God's Field," by Mr. Minns and Mr. Pindar; "Recent Discoveries about the South-East Tower of Southampton," by Mr. Skelton; "Fungii;" "Hampshire Forests and the Geological Circumstances of their Growth," by Dr. Shore; "Shells," by Mr. H. P. Fitzgerald; a paper giving in a tabulated form the private collections in Hampshire, by Mr. Dale; and "Hampshire Well Sections," by Mr. M. Whitaker.

PORTSMOUTH LITERARY AND SCIENTIFIC SOCIETY.—We are glad to learn that this Society is in a flourishing condition, and that its financial position has improved during the past year. The Society now boasts 120 resident members. The officers and Council elected for the ensuing year are as follows—President, Dr. W. H. Axford; Vice-Presidents, the Mayor of Portsmouth, Messrs. A. W. Jerrard, J. M. Ollis, and B. J. Guillemard; Council, Messrs. J. H. Ball, H. Percy Boulnois, C. Foran, W. G. P. Gilbert, and A. Howell, Captain Jackson, Messrs. Hugh S. Maclauchlan and H. Moncreaff, Dr. B. H. Mumby, Mr. George Ollis, Lieutenant-Colonel J. E. Taylor, and Dr. J. Watson; Honorary Treasurer, Mr. G. Long; Honorary Secretaries, Drs. J. Ward Cousins and A. Conan Doyle.

DIARY FOR NEXT WEEK.

Monday, May 14.—Society of Arts, Cantor Lecture, at 7 p.m.—*Decoration;* by Mr. G. Aitchison.

Tuesday, May 15.—Society of Arts, Foreign and Colonial Section, at 8 p.m.—*Emigration;* by Mr. James Rankin, M.P.

Royal Institution, at 3 p.m.—*The Plant in the War of Nature;* by Mr. W. Gardiner.

Parkes Museum, at 8 p.m.—*Sanitary Law—General Enactments, Public Health Act,* 1875, *Model Bye-Laws;* by Dr. Charles Kelly, F.R.C.P.

Institution of Civil Engineers, at 8 p.m.—*The Tay Viaduct, Dundee;* by Mr. P. Crawford Barlow. *The Construction of the Tay Viaduct, Dundee;* by Mr. W. Inglis.

Statistical Society, at 7.45 p.m.—*Condition and Occupations of the People of East London and Hackney,* 1887; by Mr. C. Booth.

Wednesday, May 16.—Society of Arts, at 8 p.m.—*Electric Lighting from Central Stations;* by Mr. R. E. B. Crompton.

Camera Club.—*Excursion to St. Albans.*

Royal Meteorological Society, at 7 p.m.—*Report of the Wind Force Committee on Experiments with Anemometers conducted at Herdran;* by Messrs. G. M. Whipple and W. H. Dines. *On the Measurement of the Increase of Humidity in Rooms by the emission of Steam from the so-called Bronchitis Kettle;* by Mr. W. Marcet, M.D., F.R.S.

Thursday, May 17.—Camera Club, at 8 p.m.—*Informal Discussion.*

Royal Institution, at 3 p.m.—*The Chemical Arts;* by Professor Dewar.

Dundee Naturalists' Society, at 8 p.m.—*Annual Meeting.*

Edinburgh Architectural Association, at 8 p.m.—*The Æsthetics of City Building;* by Mr. J. Crabb Watt.

Chemical Society, at 8 p.m.

Royal Society at 4.30 p.m.

Friday, May 18.—Royal United Service Institution, at 3 p.m.—*The Naval Defence of the United Kingdom;* by Rear-Admiral P. H. Colomb.

Royal Institution, at 9 p.m.—*La Réproduction Artificielle des Roches Volcaniques;* by M. Alphonse Renard.

Parkes Museum, at 8 p.m.—*Metropolitan Acts, Bye-Laws of Metropolitan Board of Works;* by Mr. A. Wynter Blyth, M.R.C.S.

Saturday, May 19.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner;* by Mr. C. Armbruster.

WHITEHAVEN SCIENTIFIC SOCIETY.—During the past session ten meetings were held at which papers were read, and they were all of an instructive character. At present the Society numbers 230 members, a slight increase upon the number of last year, and its financial condition is very satisfactory. The Society possesses a library and a museum, and science classes have been formed in connection with it. The following gentlemen were elected officers and committee for the coming year:—President, Dr. Jackson; Vice-Presidents, Mr. T. Gordon and Mr. G. Scouler: Treasurer, Mr. J. S. Hellon; Hon. Secretaries, Mr. E. Dobson and Mr. R. Russell; Auditors, Mr. W. Gowad and Mr. S. Broadbent; committee, Dr. Ablett, Messrs. B. Taylor, E. Crompton, J. D. Kendall, H. Adair, G. Boyd, and R. B. Gordon.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch London.—All letters, Britannia Tool Factory, Colchester, England. Makers to the British Government.

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Chisel Steel, 1 to 5 feet bars, $\frac{5}{8}$ to $1\frac{1}{4}$ octagon, 13s. per cwt.—GILBERT, Oxford Road, Sheffield.

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"Inventors' and Manufacturers' Patent and Trade Mark Pocket Guide," by G. C. MARKS, C.E., 13, Temple Street, Birmingham. Four stamps.

"Sheet Metal Worker's Instructor," Warn's; few copies, cheap, covers slightly soiled.—94, St. Augustine's Road, N.W.

Minerals, Fossils (Carboniferous, Lias), 12 specimens, 2s. 6d.; polished specimens, 6d. to 9d.—C. WARDINGLEY, Blackwood Crescent, Edinburgh.

5in. Burnishers, 7s. 6d.! Silver steel bar, warranted: $6\frac{1}{2}$ in., 12s. 6d.; 9 in., 20s.; 15 in., 40s.—C. C. VEVERS, Horsforth, Leeds.

Photographic Specialities, cheap and good.—Stills, head-rests, backgrounds, washing machines, lamps, shutters, etc. Lists free.—C. C. VEVERS, Horsforth, Leeds.

Microscope wanted, good student's; send particulars and price to RICHARD CARTER, Royal Hotel, Falmouth.

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EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

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X, Electro-Plating and Gilding taught to perfection; system inexpensive; distance no object; exchange for anything useful (stamp).—PERKS, 47, Alexandra Road, Richmond, Surrey.

SELECTED BOOKS.

Forms of Animal Life. A manual of Comparative Anatomy, with Descriptions of Selected Types. By the late George Rolleston, D.M., F.R.S. Revised and enlarged by W. Hatchett Jackson, M.A. Second Edition. London, Clarendon Press. Price 36s.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations. By A. Jamieson, C.E., F.R.S.E. Prof. of Engineering, Glasgow Technical College. With 200 illustrations and four folding Plates. Third edtion. London, Charles Griffin and Co. Price 7s. 6d.

The Fundamental Principles of Chemistry. Practically taught by a new method. By Robert Galloway, M.R.I.A., F.C.S.; Honorary Member of the Chemical Society of the Lehigh University, U.S. London, Longmans, Green, and Co. Price 6s. 6d.

Select Biological Memoirs. Memoirs on the Physiology of Nerve, of Muscle, and of the Electrical Organ. Translated under the superintendence of and edited by J. Burdon-Sanderson, M.D., F.R.S. London, Clarendon Press. Price 21s.

Electric Light Arithmetic. By R. E. Day, M.A., Evening Lecturer in Experimental Physics at King's College, London: Macmillan and Co. Price 2s.

Elementary Microscopical Manipulation. By T. C. White. Illustrated. London: Roper and Crowley. Price 2s. 6d.

Natural History Object Lessons: A Manual for Teachers. By G. Ricks. London: Isbister and Co. Price 4s. 6d.

The Hessian Fly, Cecidomyia destructor, in Great Britain in 1887: being mainly Reports of British Observations, with Illustrations from Life, and some means of Prevention and Remedy. By Eleanor A. Ormerod. London: Simpkin and Marshall. Price 6d.

The Natural History of Plants. By H. Baillon, of Paris. Vols. I. to VII., with 3,200 Wood Engravings. 25s. each.

METEOROLOGICAL RETURNS.

For the ten weeks ending Monday, April 30th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	37·8 degs., being 3·5 degs. below average.	5·3 ins., being 0·5 ins. above average.	210 hrs., being 82 hrs. below average.
England, N.E.	38·7 ,, ,, 3·9 ,, ,,	4·7 ,, ,, 1·3 ,, ,,	191 ,, ,, 57 ,, ,,
England, East	38·5 ,, ,, 5·4 ,, ,,	4·5 ,, ,, 0·6 ,, ,,	195 ,, ,, 122 ,, ,,
Midlands ...	39·0 ,, ,, 4·8 ,, ,,	4·4 ,, ,, 0·0 ,, ,,	109 ,, ,, 114 ,, ,,
England, South	39·5 ,, ,, 5·9 ,, ,,	5·1 ,, ,, 0·7 ,, ,,	184 ,, ,, 115 ,, ,,
Scotland, West	38·7 ,, ,, 3·6 ,, ,,	6·2 ,, ,, 0·6 ,, below	259 ,, ,, 11 ,, ,,
England, N.W.	38·4 ,, ,, 5·0 ,, ,,	4·4 ,, ,, 0·7 ,, ,,	223 ,, ,, 38 ,, ,,
England, S.W.	40·1 ,, ,, 5·7 ,, ,,	6·1 ,, ,, 1·8 ,, ,,	268 ,, ,, 64 ,, ,,
Ireland, North	40·3 ,, ,, 3·9 ,, ,,	5·4 ,, ,, 0·3 ,, ,,	193 ,, ,, 83 ,, ,,
Ireland, South	41·6 ,, ,, 4·0 ,, ,,	6·1 ,, ,, 0·7 ,, ,,	260 ,, ,, 48 ,, ,,
The Kingdom...	39·3 ,, ,, 4·6 ,, ,,	5·2 ,, ,, 0·1 ,, ,,	215 ,, ,, 73 ,, ,,

The highest and lowest temperatures observed during the period were 66 degs. at Cambridgs and Hereford, and 2 degs at Braemar, Scotland, E.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 20. (*New Series.*) FRIDAY, MAY 18th, 1888. [Weekly, Price 3d. By Post, 3½d.

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THE CHEMICAL TREATMENT OF SEWAGE.—The *Manchester Guardian* has published a *résumé* of Sir Henry Roscoe's recent report on deodorising London sewage. As to the use of chemicals, he reminds us that it can only be regarded as an expedient for deodorising, and for initiating a process of purification. With so enormous a bulk as that of the Metropolitan sewage, no quantity of chemicals can be added which is sufficient to change the whole of the solid matter into a harmless substance. The problem therefore is a very difficult one, seeing that a treatment to be thoroughly efficient must not only get rid of bad smells, but must maintain the wholesomeness of the river into which the sewage is eventually discharged. Sir Henry Roscoe has been making various experiments, and in his report he points out that amongst natural processes the most important is the change produced by living organisms. This change is twofold, one being due to the action of organisms requiring free oxygen for their growth, with the result that the organic matter is rendered inoffensive—the other being due to the organisms which thrive in the absence of free oxygen, and give rise to offensive products. The difficulty is to preserve the "healthy" organisms, while preventing the growth of those yielding offensive exhalations.

Apparently, the practical difficulty is to find a substance or fluid which will supply oxygen enough to the sewage to prevent its putrefaction; but in reality the difficulty is even greater. River water unpolluted holds in solution oxygen from the air, and is therefore a useful oxidising agent, but, as Sir Henry Roscoe says, the sewage on its way to the outfall undergoes a change of a putrescent character, owing to the growth of the "unhealthy" organisms. The products of this putrefactive change readily absorb free oxygen, so that when they pass into the river they deprive it of its dissolved oxygen, and the "healthy" growths cannot take place. If deodorants are added, the putrefying substances are removed by oxidation, but the treatment is far from being complete unless the deodorised sewage is brought in contact with the free oxygen which is necessary for the growth of the "healthy" organisms. It will thus be seen how complex and difficult are the conditions to be filled, and how essential it is that the subject should be investigated in a thoroughly scientific manner. Large sums of money have been spent lavishly, if not wastefully, by the Metropolitan Board of Works, in treating the sewage chemically at the outfall works, and it is now made abundantly clear that this can have no other result than to render the sewage less offensive in smell. It in no way prevents the pollution of the water, and it is of the utmost importance that means should be devised for effecting this. Sir Henry Roscoe seems to think it may be done by aerating the sewage before it enters the river, as the cost of pumping in air need not be great.

DOMESTIC ELECTRIC LIGHTING.—Notwithstanding the fact that lighting by electric glow lamps is usually more expensive than by ordinary lighting gas, the number of the former now in use is considerable. Mr. Swan stated the other day that in London alone about 250,000 are lighted up every day. We believe that the number supplied from the Grosvenor Gallery electrical station has now grown to something like 20,000, and that there is every probability of the number being further increased. The Cadogan Company have made a fair beginning, and we learn that the Kensington Court Company find it necessary to double their generating power to meet the increasing demands of the neighbourhood. We are glad to notice this extended use of the electric glow lamps, not only because they give a steady light without vitiating the air, but because there is nothing like actual ex-

perience to bring out the defects of the system, and to stimulate inventors to devise improvements.

Beyond a few evanescent schemes in connection with primary batteries, the days of juggling with shares in Electric Light Companies may happily be said to be over, and the rival firms have settled down in earnest and are now fairly competing on the merits of their work. By some the progress may be considered slow, but if we reflect that it is only during the last ten years that electric lighting has been sufficiently developed to be of use commercially there need be no surprise. On the contrary, we think that the improvements have been great and important, not only in dynamos and accumulators, but in the many engineering and electrical details on which success so much depends. So far we have confined our remarks chiefly to central station lighting, but in our next number we hope to give an account of a successful private installation on a small scale.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

M. Fleischer has recently studied the very practical subject of the relative merits of straw and peat litter for cattle and horses. As regards the comfort of the animals there appears to be but little difference, provided the peat is properly dried. The question of the farmer whose land is largely manured by his stock is, Which of these litters is the best when it reaches its final destination? From Fleischer's researches, it appears that straw contains more potash, lime, and phosphoric acid than peat, while the peat-moss litter contains more nitrogen than straw, and that when mixed with manure it absorbs the soluble ammoniacal compounds and gives them out as required. This is shown by comparative field experiments, as well as by analyses. The after effects of the peat litter is greater on light lands than when straw is employed. The experiments have not yet been extended to heavy lands.

These facts have special value to British farmers who are gradually diminishing the proportion of their wheat-crops, and consequently are, in many cases, suffering from something like a straw famine, straw being as dear as hay in some parts. Wherever peat is available its substitution should be tried. In dried form it can be carried at moderate cost—at very little cost where canals are available.

There is another kind of litter largely used for pigs by cottagers in Wales, who gather the bracken fern in the autumn from the hill-sides, where it grows in wild luxuriance. I have walked through large areas (on the Hope Mountain, Flintshire, for example) where it has risen well above my head, and it grows so thickly as completely to conceal a pedestrian.

There is an element of value in straw litter which M. Fleischer does not appear to have considered, viz., the siliceous cuticle, consisting of excessively thin plates, which, on account of their extended surfaces, dissolve more readily than sand grains, and thus supply one of the demands of grasses, especially of wheat. This is not required by root crops.

On page 377 of this Magazine is a review of Dr. Crombie Brown's work on Forestry Schools in Germany. That similar schools are desirable in this country nobody can doubt, but the magnitude of the desideratum is very imperfectly appreciated even by intelligent Englishmen. We are so much absorbed in coal-grubbing and factory-grinding that the healthier and better work of obtaining wealth from the soil is shamefully neglected. There are millions of acres of moorland and mountain slopes in the United Kingdom now lying bare and desolate that might produce immense wealth—quite sufficient to pay off the National Debt forty years hence—if planted with trees and forests in accordance with the scientific principles at present understood. The carrying out of this would, in the meantime, provide productive employment to all the able and willing workers among the "unemployed."

If the mountains of Wales were covered with pine forests from their feet to their summits, as similar mountains are in the far less favourable climate of Norway, the produce would be a thousandfold greater than is likely to be obtained by Welsh gold-mining and quartz-crushing syndicates.

I spent the best part of four summers in travelling through Ireland and studying the many physical and social problems which this perplexing country presents. I formed a very low estimate of its mineral resources. If all the workable coal in Leinster, Connaught, Ulster, and Munster —*i.e.*, all in Ireland—were brought to the surface at once, it would only supply the quantity demanded for ordinary British consumption during sixteen months. The hematite of Red Bay, etc., is nearly pushed out of the market by that of Bilbao, and the other metalliferous ores scarcely pay for working. The high expectations concerning the marble of Connemara and other building stones have been sadly disappointed. The vast stores of peat may yet be turned to profitable account, but the greatest of all the special natural resources of Ireland is just that which has been the most specially and shamefully neglected, and even wantonly destroyed, viz., its timber-yielding capabilities.

The mild, humid climate of Ireland is especially favourable to the rapid growth of the conifera and other useful timber trees. This is proved wherever a landlord has chosen to reside among his tenants, and has ornamented the surroundings of his residence with plantations. An enumeration and very concise description of such of these that I have visited would carry me far beyond my present limits. But they are all mere oases in a vast and disgraceful desert. The area of land now lying waste in Ireland is $4\frac{1}{2}$ millions of acres. Fully half of this, or more than $2\frac{1}{4}$ millions of acres, is admirably adapted for timber-growing and for the exportation of the timber after felling.

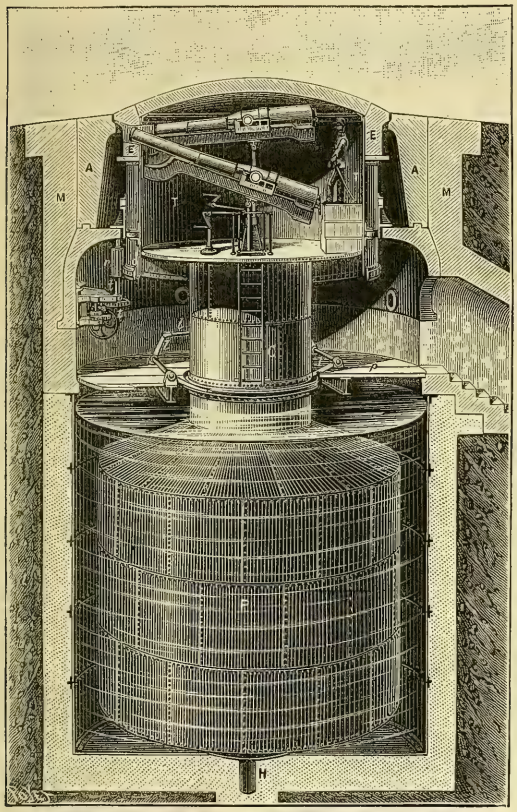
Roughly speaking, Ireland may be described as a flat or wavy-bottomed basin of mountain limestone, surrounded by a rim of mountains indented with fjords or estuaries running up to valleys forming river courses. Timber grown on the slopes of these hills could be shot down wooden slides, like those in the Tyrol, in Norway, and other timber-growing regions, and thus launched at once by gravitation into rivers or estuaries, from which they would be collected and shipped at trivial cost.

It would be very poor forestry indeed that could not —after the first ten years—obtain an average gross return progressing from £1 to £5 per acre, or, say, an ultimate continuous return of £5 per acre. This would amount to a gross revenue of $11\frac{1}{4}$ millions per annum. Of course a large proportion of this would be expended in wages for labour and other outlay, but a substantial margin would still remain for profit if the work were well managed. The whole $11\frac{1}{4}$ millions would be so much newly-created wealth, the bulk of it most desirably

distributed among those who sorely need it. Scientific forestry fully carried out in conjunction with small freeholds would cure all the woes of Ireland, provided that her politicians were simultaneously smothered.

I met with one remarkable exception to the general absence of commercial enterprise in timber cultivation in Ireland: this where I least expected to find such enterprise—viz., in the Carthusian Monastery of Mount Melleray, where the monks and lay brothers have for many years past been planting about 30,000 trees annually, and thus have created a rich forest on a slope of the Knockmealdown Mountains. (The monks hold a lease for 999 years at 2s. 6d. per acre.) This thriving forest contrasts with the dreary waste on either side of the same slope, and strikingly demonstrates the possibilities of such cultivation.

A neighbouring landlord near Cappoquin has followed their example, and thus another forest has been created with a further and very interesting result. Timber being on the spot, with a supply of water power, saw-mills have been evolved, and these again have induced the evolution of factories for the manufacture of doors, wheelbarrows, window sashes, wagons, etc., etc. This is merely a natural repetition of what has occurred in Norway, where wooden houses with all their furniture are manufactured for exportation, and every other imaginable and some unimagined wooden articles and wooden products—such as paper—have followed the supply of crude material.



Sectional View of Disappearing Gun Turret.

A DISAPPEARING GUN-TURRET.

THE importance of armour-plated turrets for cannon in the defence of fortified places has latterly increased, since neither masonry nor earthwork can resist the impact of hollow projectiles filled with so-called "high" explosives. The first step, therefore, was to mount cannon in revolving iron towers, so contrived that, immediately after firing, the embrasures could be turned away from the enemy for reloading. A further step was the adoption of the *eclipse* principle, where the revolving cylinder not merely turns on its axis, but can be raised or lowered at the pleasure of the operator. Thus its appearance above ground is only momentary, and does not exceed on each occasion the length of time required for firing.

The cylinder then at once descends entirely below the ground, where it is solidly encased and protected from the enemy's fire.

Several modifications of turrets on this principle have already been suggested, and we give here the figure and the description—borrowed from *La Nature*—of the construction recently proposed by Colonel Souriau, of the French army.

To obviate the difficulty of using complicated machinery requiring the attendance of experts for the manipulation of such an excessive weight, the inventor founds his construction upon the principle of the indifferent equilibrium of bodies plunged in a liquid.

The figure represents a hydrostatic turret T T, resting by the intervention of a cylinder C upon a plunger P. This consists of a hollow sheet-iron cylinder immersed in a reservoir of water. The cylinder C, which projects out of the water, supports the part T T. The plunger is of such dimensions as to be in equilibrium with the entire part out of the water. Hence it follows that an inconsiderable effort suffices to produce the vertical displacement of the whole, which effort may be that of a few human arms acting upon a simple mechanism. A model examined by the engineers at Creusot requires only four men to bring it into position in fifteen seconds, and to make it again disappear in the same length of time, the ascent and descent thus taking only half a minute.

All the portion E E capable of emerging is armed with Creusot plates. It is the same with the dome, which is divided into segments. The cannon-chamber is enclosed in an outer cuirass A A, which serves as a lining to the masonry M M. The turret T, the cylinder C, and the plunger P form an inflexible system well guided by the pivot H. The apparatus is thus well able to resist the shock of the enemy's projectiles.

The movements of rotation and "eclipse" are controlled by one person from the platform *p*, which is fixed.

The movement of rotation is obtained by gearing *t t*, working at two speeds. It is fixed to the lower part of the outer cuirass, and is connected with the vertical pinion *r*. This pinion works a cogged crown *d* attached

to the framework of the turret, the teeth of which remain in contact during the vertical movement.

To cause the turret to descend, the inventor makes use of a system of levers *l l l*, and they are arranged in such a manner that the speed either of ascent or descent increases from the starting point to the middle of its course, and then decreases progressively to the point of arrival.

The water in which the plunger is immersed cannot well be frozen, but if necessary it is easy to form a mixture which will not freeze at the lowest temperature to which it will be exposed.

The armament is composed of two pieces mounted, on carriages fitted with hydraulic brakes and means of returning automatically in position. Each cannon with its supports is counterpoised by a plunger arranged similarly to that of the turret. A single person can manœuvre the piece.

SOIL AND SOIL-MAKERS.

WHAT is soil? To most people merely the upper layer which, in general, is found covering the dry land, and which differs very considerably, both in its texture and its composition, according to the nature of the underlying strata, the climate, and the supply of moisture. But let us in imagination take an excursion ticket to some heavenly body, cooled down sufficiently to permit of the existence of life, but on which no life has, as yet, come into existence. Let us take our walks abroad and examine the ground beneath our feet. We shall see, and can see, there *no soil* such as we commonly meet with in this world, whether in its cultivated or its desert parts. We shall certainly find a layer of mineral matter, more or less finely broken up by the alternate action of sun and frost, by the contact of the carbonic acid in the air and that of atmospheric moisture. But it will be less thoroughly disintegrated and mixed together than the soils which we meet with. It will contain no residues of organic matter, the result of animal and vegetable life. As a consequence its power of absorbing gases and vapours from the air, and of retaining water, will be very much less than that of a true soil, containing from 2 to perhaps 8 to 10 per cent. of organic remains.

Hence, we learn, incidentally, that life can only be introduced into a world very gradually, beginning with very humble forms. Plants and trees, generally speaking, cannot grow without soil; animals, without exception, are nourished, directly or indirectly, from plants, so that, as regards the organic world, we seem to be pent up in a vicious circle: soil cannot be formed without organic life, and organic life presupposes soil. There is, however, a way of escape. The spores of certain lichens can vegetate upon a bare rock. They condense from the air gases which form the bulk of their tissues. Among their products thus obtained is oxalic acid, which gradually decomposes the rock, extracting from it those earths and alkalies which plants require as part of their structures. As centuries roll on, and generation after generation of these lowly organisms perishes, each bequeaths to its successors the lime, the potash, the compounds of carbon and hydrogen which it has gleaned from the rocks and the atmosphere; and thus gradually, very gradually, soil is formed. Higher members of the plant world and animals now by degrees put in an appearance, and the process of soil-making goes on at an accelerated rate. It will be remembered that with the *origin* of animal and vegetable species we have here nothing to do. Whether they are evolved in succession or directly successively created, the result is the same. We are here merely studying the part they take in the formation of soils.

Among the soil-makers an important, though invisible, part is played by those minute plants known collectively as microphytes. Without their aid the remains of plants and animals, unless devoured by some refuse-eating species, would simply encumber the ground, instead of being utilised for the nourishment of plants, and thus, indirectly, for the food of animals. These same microscopic beings also seize upon the nitrogen of dead organic matter, and convert it into ammonia or, according to circumstances, into nitric acid. Such nitric acid, like the oxalic acid elaborated by certain plants, assists in decomposing phosphatic minerals, rendering their phosphoric acid available as plant-food. Indeed, we are only beginning to comprehend the chemical changes which these ultra-microscopic beings effect both in soils and waters.

But in the great process of soil-making other and more powerful agents are also required. It is necessary to bring the lower portions of the soil up to the surface, and expose them, in a fine state of division, to the action of the atmosphere, of rain and dew, of sunshine and frost. It is no less necessary to carry down dead animals, leaves, stalks, and, in short, refuse generally, into the lower parts of the soil, so that the gases and vapours which they give off may be absorbed, whilst the residual solid particles are well mixed up with the mineral or non-organic portion of the soil.

This double task is executed by a number of animals belonging to very different classes. Foremost stand, perhaps, the earth-worms—if not from the predominating extent and value of their labours, yet from the admirable manner in which their economy has been studied by Charles Darwin. They draw down into their holes all small fragments of decomposing matter, vegetable and probably animal, which they find about. Not only so, they literally eat the soil, voiding it afterwards in a state of very fine subdivision. At the same time their holes admit air and moisture into the soil, and thus aid powerfully in bringing it into fine condition for the growth of plants. But we feel the less disposed to enlarge on their manner of working, and on its results, since we trust that most of our readers will have met with Darwin's work.

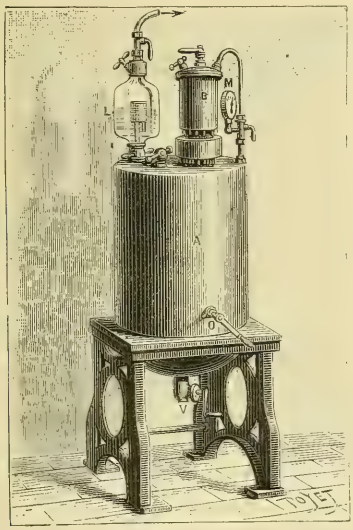
Many species of insects take a share in the same task. The so-called carrion and dung-beetles (*Geotrupes*, *Aphodius*, *Necrophorus*, etc.) dig shafts into the earth, necessarily bringing up a quantity of soil to the surface, and convey down small dead animals, excrementitious matter, etc., thus at once fertilising the lower regions of the soil, and preventing nuisance.

The so-called "white ants" (*Termes*), so numerous in most tropical and sub-tropical countries, are also diligent soil-makers. With clay and sand, which they fetch up from below the surface, they construct not merely their cities, but covert-ways leading to quarters where they plunder. As these structures gradually crumble away and are scattered in the form of fine dust, hundreds of thousands of tons of clay are thus yearly comminuted, mixed up with other matters, and converted into arable soil in a far more perfect manner than it could be done by plough, harrow, or spade. Very similar work, and over a wider area, from north to south is effected by the true ants. Professor Shaler finds that in certain sandy soils the overturnings effected by these little creatures become of geological importance. He observes that in certain sandy soils the glacial terraces and plains are covered to the depth of a foot or more with fine sand

and very small pebbles, whilst lower down pebbles of a larger size occur, the intervals between them being imperfectly occupied with any material. This condition he traces to the action of ants, which likewise carry down vegetable matter into their magazines, and do not consume the whole. He estimates that the amount of matter brought to the surface often exceeds three cubic inches per square foot yearly. Thus in fifty years as much subsoil would be brought up as would cover the entire surface to the depth of an inch.

In damp woodland soils, and along rivers, the work is taken up by a kind of cray-fish (*Astacus*). The same authority estimates that one cray-fish in America will bring up half a cubic foot of earth to the surface in a single season. As these creatures are found in multitudes, the total effect of their activity cannot be overlooked.

Not a few mammals also share in the work of up-



Apparatus for Generating Carbonic Acid Gas.

turning, loosening, and aerating the soil. But their larger size is more than counterbalanced by their inferior numbers. We have repeatedly been asked by gardeners in different districts why the soil brought up by moles, though fine and loose in texture, was generally infertile.

It has often, we are informed, been used for "potting" greenhouse plants, but with small success. This, if universally correct, is the more strange, as such mole-earth is brought up only from depths of, say, four or five inches. On this subject we should be glad of further observations.

Soil-forming, we thus see, is a task involving the agency of a vast variety of living beings, and its consideration cannot fail to impress us with the importance—in many respects the paramount importance—of small things. The subject is worth the attention at once of the geologist, the naturalist, and the practical farmer and gardener.

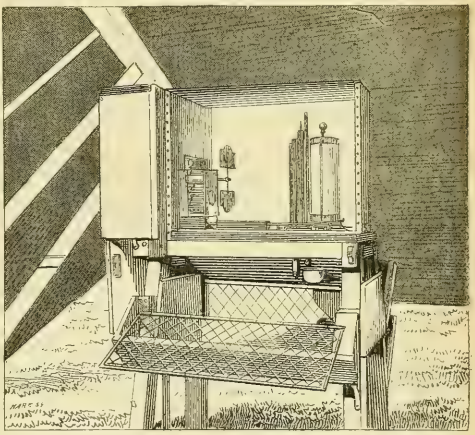
APPARATUS FOR GENERATING CARBONIC ACID GAS.

THE accompanying figure from *La Nature* represents an apparatus devised by M. Guerit, for the production of pure carbonic acid on the large scale. The gas is produced in the interior of the copper vessel A—capable of resisting a pressure of several atmospheres—by the reaction of sulphuric acid upon bicarbonate of soda. The two liquids are contained in separate vessels, and are automatically brought into contact at the moment necessary for keeping up a constant pressure in A. The gas, as it is generated, is washed, bubble by bubble, before being made use of. The solution of bicarbonate of soda is contained in A; B is the apparatus which distributes the dilute sulphuric acid automatically under the action of pressure. M is a pressure-gauge, O an agitator, L the arrangement for washing the gas, and V a cock for running off the spent matter, *i.e.*, a solution of sulphate of soda.

This apparatus was primarily devised for maintaining an atmosphere of carbonic acid in beer-pumps, and in beer-barrels partially emptied.

THE NEW THERMOGRAPH OF THE ROYAL OBSERVATORY, GREENWICH.

A NEW thermograph for photographic registration of the temperature of the air, and of the temperature of evaporation, by means of the dry bulb and wet bulb thermometers, has lately been erected at the Royal Observatory, Greenwich, of which, by the kindness of the



Thermograph at the Royal Observatory, Greenwich.

Astronomer-Royal, we are enabled to give the accompanying illustration. It is an improved apparatus, replacing that set up at the Royal Observatory in the year 1848, which was one of the first employed for systematic record by photography of the elements in question. The new apparatus is on the same general plan, the improvement being in details. A fine vertical slit is placed in front of the column of mercury of each thermometer, and the flame of a gas-lamp (one for each

thermometer) shines through that part of the column not occupied by mercury, which, in the case of the dry bulb thermometer, is all that part of the tube above the mercury, and in the case of the wet bulb thermometer a long air-bubble occupying about 12° of the scale. The light passing through the thermometer-tubes is received on sensitized paper placed on a revolving vertical cylinder immediately behind the thermometers, which stand side by side, the light in each case entering at such an angle that the record of the wet bulb thermometer appears precisely below, on the paper, that of the dry bulb, the lower edge of each trace being the proper thermometric indication to be employed. Degree-marks cut on the stems of the thermometers and painted, appear on the photographs, when developed, as white lines, the 10-degree lines being thicker than the others. Thus the photographs carry their own degree scales. The driving clock at each hour interrupts the traces for a short time, giving corresponding hour lines on the registers. The apparatus is enclosed in a metal case, the bulbs of the thermometers projecting below, and being about 4 ft. above the ground. The whole apparatus stands under a louvre boarded shed, under which there is free circulation of air. The apparatus was constructed by Negretti and Zambra. The illustration supplied by Mr. McClellan, of the Magnetical and Meteorological Department, is from a reduced copy of a view taken by Negretti and Zambra. One side of the metal case is shown removed, in order that the general internal arrangement may be seen.

PHOTOGRAPHIC LENSES.

THE lens is the most important item of the photographer's outfit. To be thoroughly equipped for all kinds of work three types of lenses are essential, namely, a single, a rectilinear doublet, and a wide-angled one.

Most writers in the photographic primers recommend the amateur who can only afford one lens to begin with, to purchase a "rectilinear doublet." This, however, is not the best advice.

For all-round work, save of course purely architectural subjects, nothing can compare to a really first-class single lens. For speed, for flatness of field, for depth of focus, in fact for everything, except rectilinearity, nothing can approach it.

By "depth of focus," of course, is meant the power in the lens to represent sharply objects near, as well as those at a distance from the lens. By "flatness of field" is meant the power in the lens to give perfect definition even to the margins of the picture.

Naturally, every beginner wishes to possess a quick-acting lens, but he must bear in mind what he gains in speed he loses in flatness of field and depth of definition.

By "width of angle" is meant the "sweep" of picture given without falling off of definition towards the margins.

The width of angle of a lens entirely depends upon the relation of its size to its focal length; that is to say, the shorter the focus the larger the angle, the longer the focus the smaller the angle.

Very wide-angled lenses are dangerous tools to use, especially for architectural subjects in cramped positions, as frequently they will so distort a view as to render it almost unrecognisable. Its legitimate field is more in landscape photography, to which absolute accuracy may be reasonably sacrificed to artistic effect.

The best form of view lens is the "single meniscus" type, which undoubtedly gives the most brilliant pictures.

It is equally as rapid as the "doublet" worked at the same focal aperture, if not even more so, although many amateurs are under a false impression on this point. As Captain Abney points out in his splendid treatise on photography, "the loss of light from reflection by the surface in the single type of lens is the least possible." Its only drawback is that it gives slight distortion, rendering straight lines near the margins curved or barrel-shaped. It is therefore unsuitable for architectural subjects. This, however, will not be so much noticed if the straight lines of the building do not occupy the extreme edges of the picture.

Other things being equal, the smaller the diameter the better the lens.

For architectural subjects, interiors, some kinds of instantaneous effects, copying, and enlarging, a rectilinear doublet is the best, and one of moderate angle is to be preferred.

Exposure is the great bugbear of the beginner, and this because many amateurs are in utter ignorance of the focus of their lens, and the proper use and value of their diaphragms.

If the focus of a lens be not known, its discovery is a simple matter. Sharply focus some object over twenty yards distance. Then measure accurately the distance between the focussing ground-glass, and the single lens, or if the lens be a doublet, from the ground-glass to the diaphragm slit. This will be the focal length of the lens. Next measure very carefully the diameter of each stop aperture. Then, in order to find the focal value of each stop, divide the length of focus by each diameter. For example, say the focal value of the lens is *nine* inches, and the diameter of the largest stop *one* inch: then $9 \div 1 = 9$, so that the value of that particular stop will be expressed by F 9.

It goes without the saying that the smaller the stop used the longer the exposure required.

In order to ascertain the relative exposure of stops, square the focal numbers.

For instance, if the correct exposure of a landscape with F 10 stop was *one* second, F 12 would require $1\frac{1}{2}$ seconds, F 16 $2\frac{1}{4}$ seconds, and F 40 16 seconds.

It is thus evident that lenses are more or less rapid in action as their *working* diameters are larger or smaller, or as their equivalent focal lengths are shorter or longer.

The size of the picture too is determined by the focal length. The proper distance to place subjects for portraiture from the lens should not be less than twelve feet or more than thirty.

In portraiture, too, tilting the camera forward is an advantage rather than otherwise, as it produces a more pleasing view of the face than if the camera was perfectly level.

Just a final word or two on the proper use of stops.

The most brilliant results are obtained by using the largest possible stop, which will bring all the picture into the requisite focus. By using a large stop, breadth and atmosphere, as well as brilliancy, are secured in the picture.

Always make a rule of focussing the central object of interest in the picture with the largest stop. This done, insert the next largest stop, which will give the necessary sharpness all over the picture. The distance should not be rendered, however, too sharp, if the picture is to be artistic.

Always carefully dust a lens before using it.

General Notes.

Short-sightedness.—Professor Stilling, of Strassburg, concludes that there is no foundation for the prevailing opinion that this affection is due to bad type, bad desks, or bad light in study.

The Severe Winter.—In consequence of the exceptionally severe weather experienced in Canada, an ice-bridge was formed completely across the river, just below the Niagara Falls. Several persons are said to have crossed it in safety.

Resistance of Concrete to Shell Fire.—From experiments recently made in France it appears that cement concrete offers greater resistance to shell fire than armour plate, and consequently a proposal has been made to face the existing casemated forts with concrete.

Antiquarian Discovery.—This week, while some improvements were being made on the estate of Mr. A. Maudslay, Twyford, near Winchester, the site and remains of a Roman villa were discovered. The excavation was being carefully carried on under Mr. Maudslay's supervision.

New Minor Planet.—Minor Planet No. 277 was discovered by M. Charlois at the Nice Observatory at 12 h. 25 m. a.m. on May 4th, in right ascension 13 h. 42 m. 6 secs. (decreasing 44 secs. daily), and North Polar distance 101 degs. 13 m. 43 secs. (decreasing 4 m. daily).

A Sanitary Blunder.—Dr. E. Verrier, writing in *Le Voltaire*, protests against the practice of warming schoolrooms by means of gaseliers kept burning during the daylight. This practice increases the quantity of carbonic acid in the rooms—often not efficiently ventilated to begin with—fatigues the eyes, and is apt to heat the heads of the scholars, whilst allowing the feet to remain cold.

Value of the Mineral Constituents of Water.—Dr. N. A. Randolph mentions that minnows which throve in brook-water, and remained alive in it without food for many days, died in a few hours when placed in distilled water properly aerated. He holds that one of the chief dietetic advantages of salads and uncooked vegetables in general is that the mineral elements have not been removed out of them.

New Departure in Dyeing.—M. Bandsept (*Le Voltaire*) proposes to use, in dyeing or printing tissues, instead of solutions, solid colours in fine powder, which are to be projected against the cloth by a jet of compressed air or superheated steam. If the substances used are sensitive to light or to the electric current, they may be decomposed or modified by these agents at the instant when they are incorporated with the tissue.

Thermic Waters.—According to the *Londoner Zeitung*, after an earthquake shock at Puzzuoli, known in antiquity as Forum Volcani, the four mineral springs there became turbid, and rose in temperature from 144° to 160° Fahr. At the distance of 300 yards from the great crater, out of which fumes and sulphurous gases always issue, the earth opened, and steam was emitted at the temperature of 212° Fahr.

Spectrum of Acid Methhæmoglobine.—M. H. Bertin-Sans (*Comptes Rendus*) has proved that this spectrum consists of four bands; the first very deep; the second, less marked, has about the same breadth as the first. The third, intermediate in intensity between the two former is about twice as broad as the second. The fourth, deeper than the second or third is broader than the third.

Inorganic Evolution.—Mr. E. A. Ridsdale, in a pamphlet which we hope shortly to notice at some length, has introduced into the discussion of this question a novel and important principle; the "survival of the most inert." That is, as the strongest affinities of the elements are satisfied, the compounds which, under the existing circumstances, are the most stable are formed and remain, whilst instable compounds then and there disappear.

Seismometers.—*Cosmos*, criticising the instruments used for detecting and recording earthquake shocks, and showing their direction, remarks that they are not respectively comparable, and are not set up in the same manner. The best method of fixing such apparatus has not even yet been determined. Mr. Milne, in the *Seismological Transactions of Japan*, makes the curious observation that light objects supported on one side fall more readily than such as stand free and are capable of falling in all directions.

The Royal Zoological Society of Ireland.—This society, according to its report recently published, is not in a satisfactory condition. The number of visitors during the last year has been less by 4,500 than in the year before and much lower than in any year during the past ten years. The decrease in attendance is most marked among the lower classes, the visitors who paid two pence each for admission having fallen off by upwards of five thousand, and those admitted for one penny each by nearly two thousand.

Photochromatic Properties of Chloride of Silver.—This substance has the peculiar property of receiving and retaining for a time the colours of incident solar light. G. Staats. (*Ber. Deutsch Chem. Gesell.*) shows this by dipping a plate of polished silver into a five per cent. solution of ferric chloride. The plate at once takes a slate-colour verging upon violet. In ten seconds it is taken out, quickly dried with a cloth, and covered with cherry-red, emerald green, orange-coloured, and blue (corn-flower) glasses. In sunshine these colours appear upon the plate in a few minutes. If exposed too long they take a brownish cast. This interesting phenomenon has not yet been explained.

"Cold" and Incendiary Lightnings.—Julius Spiers (*Humboldt*) has examined the behaviour of electric sparks which strike along the surface of water. He finds that they pass through a tenfold greater distance than in dry air. Their igniting power is much increased. If a charge is not strong enough it produces "cold" lightning in dry air, *i.e.*, it does not ignite combustibles. But near a surface of water it produces a gliding spark which ignites. This explains why lightning often

kindles wet thatched roofs, and why it strikes trees, often stripping the bark without shattering them; why the neighbourhood of waterfalls, of overflows from cisterns, and even of brooks and streams is dangerous.

EARTHQUAKES.—A severe shock was felt on the west coast of Norway on April 2nd. On April 18th a shock lasting for about two minutes was felt in the South of Sweden. According to the *Chilian Times* of March 10th, a series of earthquakes, commencing at 1 p.m., were experienced at Caracoles on February 24th. The shocks were also felt at Calama and Sierra Gorda. A shock of earthquake was experienced at Valparaiso at 6.35 a.m. on March 10th. A smart shock of earthquake, followed by a loud subterranean roar, was experienced at Quillota on the 6th at 6.30 a.m. A severe earthquake shock was experienced in Ovalle on the 5th at 5.19 a.m. The shock was also felt in Serena, where it lasted 40 seconds. The direction of the wave was north to south. The shock was also felt at Illapel.

A RIVER PHENOMENON.—The river Mersey in the vicinity of Warrington Bridge has presented a startling appearance on several evenings recently. Bubbles of spontaneously inflammable gas have been rising in patches on its surface, bursting into brilliant flame on contact with the air, with an effect so weird as to lead to much speculation and wonderment amongst the numerous spectators who have gathered to witness the phenomenon. At times the flashes of light have coruscated on the river in large tracts, emitting a bright light accompanied by a noise like miniature artillery. The cause is variously assigned to some experiments which are being made for the purpose of devising a signal light for use at sea, or the natural formation in the muddy bed of the river of phosphuretted hydrogen, which bursts into flame on contact with air.

ELECTRIC FIRE ALARM.—According to the *Electrical Engineer*, M. Pian has devised a very simple apparatus for indicating a rise of temperature in any portion of a building. The essential part is a glass globe, the neck of which is closed by a membrane which, by the expantion of the contained air, is made to close the circuit of a battery and bell. The apparatus is regulated by means of a screw, carrying one of the platinum points being brought into contact by the inflation of the membrane, while the other platinum point attached to a spring in close proximity to the membrane. In order to render the instrument independent of barometric and ordinary temperature variations, it has been found advisable to establish a communication, by means of a minute orifice, between the enclosed air and the surrounding atmosphere. By means of this device only sudden variations of pressure, such as would be due to a current of heated air arising from combustion, are indicated. The apparatus should be placed at a considerable altitude above the floor; and we think that the objection of fragility might require to be obviated by the use of a globe or other vessel of copper, in lieu of one of glass.

OBITUARY.—It is with regret that we have to record that Professor Segmund Wroblewski, of the University of Cracow, has succumbed to the effects of the severe burns which he met with while working in his laboratory. Dr. Wroblewski has contributed several important papers to the scientific press upon his work on the liquefaction of the so-called permanent gases. By much labour and perseverance he has succeeded in completing the work which the French and Swiss chemists MM. Pictet and Cailletet started, and some three years ago his efforts were crowned with a successful experiment, in which he obtained atmospheric air in a liquid form. Besides liquefying oxygen, nitrogen, and hydrogen gases, and determining the temperatures at which these elements when in a liquid state boil, Dr. Wroblewski was the first to freeze carbon bisulphide and alcohol into a solid condition. Before his work in this direction all attempts at the solidification of these two liquids had failed, but with the appliances which had so successfully aided him in his researches with the gases we have mentioned he succeeded in obtaining solid alcohol, and thus confirmed our theories in respect of this liquid. Professor Wroblewski was born in the year 1848, and studied at St. Petersburg and Strasburg. He was appointed to the chair of experimental physics at Cracow in 1882, and his chief work has been accomplished within the last few years. The fatal termination to his accident has caused the loss of a careful investigator in a branch of physics which is of more than usual interest.

PETROLEUM LAMP EXPLOSIONS.—Herr D. Fock, in a lecture delivered before the Prussian Industrial Society, in Berlin, gave an account of some experiments made by the German Standards Commission. If a petroleum lamp be not full, the upper part of the reservoir contains air charged with petroleum vapour, the proportion of which depends on the character of the oil and upon its temperature. Let a flame enter, and there is ignition, which, in a closed reservoir, may produce a pressure of fourteen atmospheres, or 210 lbs. to the square inch; but the force of this explosion depends upon the ratio between the air and the petroleum vapour present; the most violent explosion is produced by a mixture of forty-three air, and one petroleum-vapour; if the mixture be poorer or richer than this, the combustion is slower and the action less violent. The temperature at which petroleum will give off so much vapour as to flash, is the "flash-point;" some 8° C. above this is the temperature at which the most violent gaseous mixture explosion is probable; and some 4° C. still higher up the scale is the "kindling point," at which the petroleum itself will ignite when flashed, but at which there is no danger of explosion in a closed reservoir, the proportion of vapour present being too great. Fock points out that actual explosions of the oil reservoir are almost unknown; he has tried to produce explosions in some 1,500 lamps, and only succeeded once, for even cracked ones do not explode; the internal pressure is, under normal circumstances, relieved through the wick holder. The result of the investigations of the Commission is that the risk of explosion proper is very small. The explanation of the numerous fatal accidents appears to be rather that in a warm room, or from the flame heating the lamp itself, the petroleum has reached its "kindling point," which lies in common commercial petroleum at about 33° C., or 91·4° F., the copious vapour produced comes up the wick tube, mixes with air, and burns in the wick; the wick holder is heated, something cracks; and the petroleum bursts into flame. To avoid this, glass reservoirs should be strictly tabooed; they should be of metal or some material which would not be likely to crack when heated in the above way.

THE CANINE TEETH OF MAN.

BELIEVERS in the theory of evolution, as applying to the development of the human frame, have no doubt often wondered in what manner prehistoric and unintellectual man contrived to hold his own in the world. Compelled to bear his share in the struggle for existence, while not as yet possessed of reasoning powers which might enable him to compensate for his physical shortcomings by artificial means, he would seem to have been placed at so great a disadvantage in the natural and compulsory warfare that his survival as a species is almost inexplicable, unless upon the supposition that in those remote ages he was furnished with weapons, material or immaterial, not granted to him now. Compare man, physically speaking, with various members of the brute creation. His organisation, superior in some ways, is very far inferior in all the attributes which would profit him in the daily conflict with his fellow-creatures. Of all the animals upon which he so largely depends for food, there are few indeed which would not be able, were he deprived of his mental capabilities, to set him utterly and absolutely at defiance. Some are more swift of foot than he; some superior in muscular strength; some furnished with formidable weapons which would render personal encounter a hopeless undertaking. Others are adepts in the arts of concealment, and would be discovered, if discovered at all, principally by accident; while those which fly through the air, which burrow through the earth, or which swim through the water, would practically be beyond all hope of attainment. Animal food, therefore, to primitive and unarmed man—and a semi-vegetarian dietary is in great measure a concomitant of civilisation—could be obtained

HEAD OF GORILLA.

only with difficulty, and upon very rare occasions, by reason of his physical disabilities for the pursuit and the slaughter of his victims.

But there is another and a still more important side to the question. The struggle for existence is not a one-sided conflict only, but is reciprocal; and man, preying upon certain animals, is himself preyed upon by others. What bodily weapons does he possess with which he may defend himself against these? He is not sufficiently fleet of foot to escape from them by flight; he is not fitted, like the monkeys, for a life in the trees; he is not strong enough to venture upon actual combat; nor does he possess talons, beak, tusks, or fangs which might give him the advantage in a personal encounter. How, then, is he to hold his own until such time as his developing intellect may compensate for his bodily weakness?

That he did so hold his own is obvious enough from the mere fact of his existence and his pre-eminence now; that he must have done so, in the first place, by means of physical qualifications is almost self-evident. What, then, were the means?

HEADS OF WARRIORS ON OLD PERUVIAN POTTERY.

Probably these were varied. The savage excels his civilised brother in almost every bodily attribute. Swifter of foot is he, more enduring, more muscular, keener sighted, more sensitive of ear and of nostril. And as the savage bears to primitive and unintellectual man much the same relation as that which the nineteenth-century Englishman bears to the savage, analogy would lead us to conclude that these same physical qualifications must have been developed in still greater degree in our primæval and unreasoning ancestors. But it is, at any rate, not impossible that in these fathers of our race certain specialised weapons were present, which now have partly or wholly disappeared through the natural and inevitable degeneration which follows upon long disuse. And we may even speculate, without altogether leaving the realms of scientific inference for those of imagination, that the principal of these weapons consisted of the Canine Teeth.

What have we by way of grounds for such an assumption?

In the first place we have analogy; for we find that the canine teeth of the higher monkeys, which stand nearest to man in the arrangement of nature, *are* developed in such a degree as to be fit for use as weapons, and not uncommonly must be described as "tusks" rather than as pure and simple teeth. In the gorilla, for example, they project to the distance of at least an inch and a half from the jaw, and are especially conspicuous in the male animal. In the orang-outang they are even more prominent, and constitute weapons of the most formidable character, while in the chacma, and indeed in all the baboons, they are of the very highest importance. A chacma is more than a match for the largest and most powerful dog. Plunging its teeth into the unfortunate animal's throat, it thrusts its victim forcibly away, while still retaining its hold. The consequence is that the sharply-edged canines cut through muscle, vein and artery like so many razors, lacerate the im-

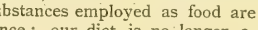
portant vessels which carry the blood to and from the head, and a second later the wounded dog is lying on the ground, the life-blood pouring in volumes from its mangled throat.

So much for the analogy of the monkey. But we have also the analogy of the savage.

In uncivilised races *all* the teeth are superior in size, strength, and quality to our own, while flesh—and even raw flesh—is torn by the incisors and canines with perfect ease. Cookery, with a savage, is an art seldom brought to any great degree of perfection. He slays his victim, cuts a slice or two from any part of its body which he may fancy most, and after roasting it more or less incompletely at his fire, tears it to pieces and devours it. Sometimes he dispenses with cooking operations altogether, and swallows his meat raw. Hence the labour thrown upon his teeth is increased, and they, answering to the demand upon them, continue year after year, and generation after generation, in a state of perfection almost unknown to dwellers in civilised countries. And the canines especially, in ourselves the most useless of all the teeth, are available and efficient for purposes which our own could never fulfil.

But we do not depend in our argument wholly upon the analogy; we have also a very suggestive fact. For upon some of the old Peruvian pottery we find pictorial representations of ancient warriors depicted as possessing well-developed canine *tusks*, projecting to some little distance from the mouth.

This fact is very remarkable; and if in Peru, why not in other parts of the world as well? The present small size and feeble powers of the teeth in question are amply accounted for by the degeneration ensuing upon century after century of disuse; just as doctors are telling us now that our modern refinements in cookery, by minimizing the labour thrown upon the teeth, are gradually diminishing the quality and utility of molars, præ-molars, and incisors alike. Of course in this matter the substances employed as food are not without their influence; our diet is no longer a natural one. But diminished exercise of any bodily member invariably leads in the end to partial or complete atrophy; and such atrophy tends eventually to become hereditary. Hence the present uselessness of man's canine teeth affords no proof whatever that in bygone ages they were as we see them now. The presumption, drawn from analogy, is that before man became an intelligent and reasoning being, his canine teeth were sufficiently large and strong to serve him as weapons, probably, but not necessarily, in conjunction with other portions of his frame. The old pottery seems, at any rate, to give colour to this supposition. And therefore it is more than probable that in primæval man these teeth *were* weapons, and that they have since lost their character simply owing to the fact that we no longer have need of their services.



Alcoholism and Criminality.—M. Marambet, in a communication to the Academy of Medicine, stated that after examining 3,000 convicted criminals he found that of the vagabonds and the mendicants 79 per cent. are drunkards; of the assassins and incendiaries 50 and 57; of robbers, 71. Of those convicted of crimes against the person 88 per cent, and those guilty of attacks on property, 77 per cent. are alcoholics. Of 100 criminal youths under twenty, 64 are already drunkards. Drunkenness has greatly increased in France since the consumption of spirits has been substituted for that of wine.

THE STORM AT DACCA.

In his report upon the recent terrific storm at Dacca, the Government Meteorological Reporter gives the following explanatory history of the phenomenon:—

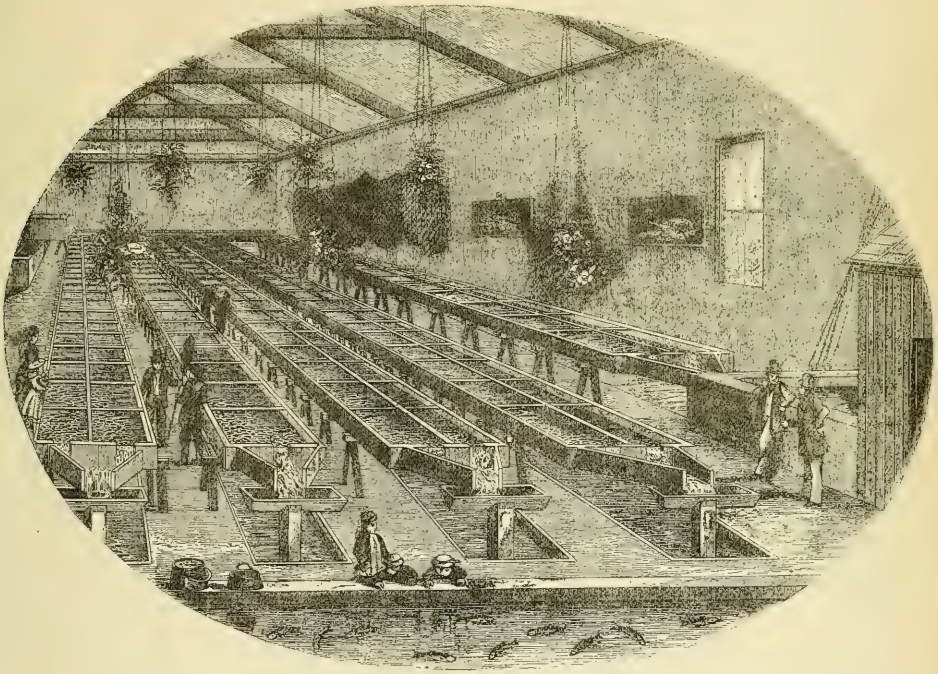
"A moisture-laden current, which on the 6th was confined to the south of the province, had advanced between the 6th and 7th in a northerly direction, and had on the morning of the 7th penetrated as far as Central Bengal, as represented by Berhampore; and in the southern part of North Bengal, as represented by Rampore, Maldah, and Rungpore, but it failed to reach as far as Dinagepore. The moisture-laden current was, however, driven back at 10 a.m. on the 7th, and by 10 a.m. on the 8th the dry westerly wind had almost completely re-established the former position. These fluctuations in the area occupied by these more or less opposite winds were unusually large and well marked, and such cannot happen unless the atmosphere is in a somewhat disturbed condition. The result of such a conflict of more or less opposing winds, varying so largely as to humidity, is usually to produce local storms known as north-westers, and, as a matter of fact, during the first few days of the week local storms were reported from several stations in the Dacca, Chittagong, Noakhally, and Tipperah districts of East Bengal. The usual local storms or north-westers were accompanied by the formation of a small but very violent tornado or whirlwind, which passed through Dacca and the neighbouring district on the evening of the 7th, causing much destruction to life and property throughout its course. It is very rarely that Bengal is visited by storms of this type. On account of the suddenness of their appearance, their short duration, the small path over which they act with destructive violence, and the difficulty of obtaining trustworthy and accurate accounts of the phenomena preceding and attending them, no attempt has hitherto been made to work out scientifically the subject of Indian tornadoes. Two or three only have in fact been described. On the other hand, tornadoes of the most violent character are rather frequent in parts of the United States, and the scientific work which has there been done clearly shows that the atmospheric conditions which appear invariably to precede the formation of tornadoes are violent contrasts of temperature and humidity immediately to the north and south of the path to be traversed by the storm. From the above description of the weather in parts of the east and north of Bengal at the beginning of the week, it will be seen that the conditions were precisely those invariably found to precede tornadoes in the United States. In addition, however, to these antecedent conditions, there must be some particular cause or set of causes which must determine the formation of a tornado, but of which nothing at present is known, for similar, though perhaps not such violent, contrasts of temperature and humidity in different air currents in Bengal frequently happen at this season of the year; yet in most cases they are only followed by the formation of dust storms and north-westers, which are sometimes very fierce. It is only from the presence of unknown and exceptional conditions that perhaps once in five or ten years excessively fierce whirlwinds, tornadoes, or even waterspouts are formed, instead of the usual class of Indian hot-weather storms. Much doubt exists as to whence the enormous energy displayed in tornadoes is derived, but it is possible, as in the case of cyclones, the energy is derived from the condensation of aqueous vapour into rain; for in most tornadoes torrential rain follows after the passage of a storm."—*Times*.

Natural History.

FISH CULTURE.

The first difficulty which occurs to the observer with respect to the multiplication of fish is to explain how it is that many species should be, comparatively speaking, so rare, though the ova which they annually produce may be counted by thousands. But on closer examination we find so many enemies besetting the baby-fish, from its leaving the egg to its reaching a size fit for human food, that we may almost wonder how any survive. We either flee or defend themselves they are beset by water-beetles, water-scorpions, the larvæ of dragon-flies, not to speak of greedy fishes, both of other species, and even of their own. The want of suitable food often causes multitudes to perish.

To obviate all these difficulties and to secure an ample supply of fish suitable for human food systems of artificial propagation have been adopted, and that with a very decided success. The fecundated spawn is placed in breeding-boxes or tanks, constantly supplied with fresh, pure water, at the temperature best suited for the development of the fry. All enemies are carefully



Hatching House, with Breeding Boxes, of the Solway Fishery, Dumfries, N.B.

leave here, of course, on one side all the havoc occasioned by polluted waters, by the influx of acids, alkalies, metallic salts, and other poisons into our streams, or by the presence of putrescent matters which render the fish liable to fungoid diseases. These are evils which it is hoped that legislation on the contamination of rivers will ultimately overcome or reduce to a minimum. But let us take a stream or a lake of fairly wholesome water, well aerated, and receiving neither house sewage nor industrial waste waters. Even here fish-life in its earlier stages runs fearful risks. The spawn before it is vivified is liable to be devoured by water-fowl, by crustaceans (cray-fish), by mature fishes, and, we believe, by certain carnivorous insects. When the young fry are first hatched out, and before they can excluded, and the young fishes are supplied with food, consisting generally of boiled liver very finely minced. Our illustration gives a general view of a fish hatching-house, with its breeding boxes as established at the Solway Fishery, Dumfries, by Mr. J. J. Armystead.

After the fish have reached a sufficient size they are allowed to pass from the breeding-boxes into the river, and in future to shift for themselves. Much has been effected in this manner in the United States and in several parts of the Continent, though Britain, from a variety of causes, has so far remained in the background.

But fish-culture has not yet reached perfection, and there is therefore room for the improvements devised by Messrs. Paul and Reisenberger, and about to be carried

into execution on the large scale by the British Fish Culture Society, whose prospectus is now before us.

The most prominent feature in the new process is the substitution of a natural food, for the chopped liver which has been hitherto supplied. This natural food consists of minute living animalculæ, such as Entomostraca, Vorticellæ, etc. These little creatures multiply in water with singular rapidity, and Mr. Paul has devised a method of breeding them so readily that food for any conceivable quantity of fish can be obtained with very little trouble or expense.

The advantages of this animalcular food as compared with liver are that it is much more completely digested and assimilated. Of the liver nearly three-fourths are excreted by the fish without being utilised. Bits of liver too escape uneaten, and hence much trouble is thrown upon the keepers, since, if such impurities are not removed, they putrify and cause the fish to perish. It has been found in actual practice that trout and salmon fed upon this natural food grow three times more rapidly than such as are reared upon boiled liver, whilst their flesh is more wholesome and more palatable.

A second improvement which Mr. Paul proposes is that the fish, instead of being passed at once from the breeding-boxes to the rivers, are kept in graduated ponds and tanks, where they can be protected from many of their enemies, and where they can receive a regular supply of food. By these arrangements it is rendered possible to rear 900 out of every thousand ova laid by a trout or salmon, instead of one (!) as is the natural average.

A further step in the right direction is Mr. Paul's method of fattening fish. We are informed that fishes measuring only 6 in. have been brought in twelve months to a length of 20 in. and a weight of 12 lbs. on his system.

If this process succeeds—and succeed it must, from the facts already ascertained, if it only meets with fair play—several beneficial results must follow; such, for instance, as an increased supply of human food at non-prohibitive prices.

Of course we are aware of the contempt in which "coarse fish"—*i. e.*, any fresh-water fish save trout and salmon—is held in England. But the fault lies not in the fish, but in the methods of cooking.

That this Society has our best wishes scarcely need be said.

The Growth of Plants.—According to the *Annales Forestières* a person not named, at Avignon, has been repeating the celebrated experiment of Helmont. He took 100 kilos. of soil, dried it in a stove and put it in a stoneware pot. The soil was then moistened with rain-water, and a willow was planted in it weighing $2\frac{1}{2}$ kilos. For five years the soil was carefully moistened with rain or with other water. The willow grew and increased admirably. In order to prevent the introduction into the pot of other earth or of dust, it was covered with a metal plate perforated with a great number of fine holes, so arranged as to give access to air only. (If air can find access dust will certainly not be excluded). At the end of five years the tree was pulled up, and its weight was found to be about 85 kilos., not including the weight of the leaves which had fallen off every season. When the earth had been dried it was weighed again, and was found to have lost only 60 grammes. Therefore nearly 80 kilos. of woody fibre, bark and roots had been produced. What was their source? In addition to the carbonic acid of the air which the *Annales* mentions, the ammonia of the atmosphere and the mineral matter present in the water must be taken into account. The experimentalist does not seem to have determined which part of the gross weight of the tree was moisture.

Struggle for Existence.—M. L. Speich writes in *Cosmos* that the walls of a room in his house are hung with a paper having a white ground covered with a pattern of yellowish figures, terminating in points. Entering this room, which was unoccupied, he noticed that a number of these points seemed rather deeper coloured than the rest. On close examination he found, sitting on each, one of those little moths the despair of housewives, placed with its head towards the point of the design, whilst the margins of its wings coincided exactly with its outline. Thus placed and flattened upon the spot selected, these insects were almost invisible.

A New Fossil Fish from the Coal Measures of Commentry.—M. Charles Brongniart (*Comptes Rendus*) describes certain specimens from Commentry which form the types of a new order, pleurocanthides, the ancestral and synthetic group of the true sharks, the rays, the Port Jackson sharks, the *Chimaerae*, the sturgeons, and the *Ceratodus*.

The Food of the Tawny Owl.—According to the *Newcastle Weekly Chronicle*, there is at present on Derwent side a nest of this species containing six young ones, a very unusual number. On the nest there had been laid out twenty-five full grown mice and six halves of mice, including house-mice, field-mice, harvest-mice, and dormice. Such a bill of fare ought to plead convincingly for the protection of this useful bird.

Influence of the Moon on Crustaceans.—Mr. E. L. Layard, British Consul at Noumea, writes (*Field*) that a certain crab found in the islands of the Western Pacific is "full of splendid meat" if taken at full moon, but if captured at new moon it is worthless, the flesh being flaccid and watery, and the animal very much reduced in weight. He seeks to account for this fact by suggesting that at full moon the crabs can see better to capture their prey.

Exploration of Iceland.—During the coming summer—if one does come — the Danish Government purposes despatching an expedition to Iceland to survey the coasts and take soundings.

Capture of Myrmekophilous Insects.—This name has been given to certain beetles and other insects as well as spiders and mites which live in ant-hills, and from some unknown reason are not devoured by the inhabitants. Most of them are very rarely met with in other localities. To capture such insects without having the hands, arms, and probably the face covered with ants, Dr. W. Behrens proposes (*Stettin Entom. Zeitschrift* and *Humboldt*) the following method:—The lid of a common paper box is perforated with holes of about $\frac{1}{4}$ inch in diameter. A bit of cheese is put in the box, the lid put on, a cord of about a foot or 18 inches in length is tied to the box, which is then buried in the ant-hill.

The next day the place is revisited, the box is quickly drawn out by means of the cord, placed in a larger box and carried home for examination.

Crickets in Algeria.—A cricket, species not named, distinct from the locust and the grasshopper is ravaging Algeria. They leap like grasshoppers, but have a more rapid and sustained flight. Their swarms are so numerous as to darken the sun, to destroy all vegetation and when they die to cause a serious nuisance. Trains between Constantine and Batna are said to have been stopped by these insects. The authorities have already spent 700,000 francs in combatting this scourge and purpose expending a million more.

Teeth of the Ornithorhynchus.—According to W. S. (*Wesley Naturalist*) Mr. E. B. Poulton, M.A., F.E.S., has discovered true mammalian teeth under the long plates of the jaws of *Ornithorhynchus*. It is suggested that this species and its allies *(Monotremata)* may be, not advancing reptiles, but degraded mammals. Professor St. George Mirart thinks it likely that the *Monotremata* have become mammalian along a different line from that which was followed by the higher mammals, and that the ordinary idea of the *Platypus* as being the transition-form between *Sauropsida* (reptiles and birds) and mammals is inaccurate. He had contended for the last twenty years for the independent origin of similar structures in different animals, and this discovery of true teeth in so low a mammal as *Ornithorhynchus* lends a support to his views.

Animal Power of Resisting Poisons.—Several cases of the resistance of certain snails to poisons are on record. Krukenberg tells us that *Helix pomatia* can bear perfectly doses of nearly $\frac{3}{4}$ grain of sulphate of strychnine, but it perishes in an atmosphere of camphor. *H. aspersia* succumbs to a dose of strychnine sulphate less by one half. *Zonites algirus* resists strychnine as well as does *H. pomatia*.

American Plants in the Eastern Hemisphere.—Mr. F. T. Law *(Wesley Naturalist)* mentions several American plants which have wandered into the Eastern hemisphere, and spread from Britain to Japan. Among these are the chickweed, winter-green, the marsh-marigold, dogwood, guelder rose, golden saxifrage, vervain and lily of the valley. It is supposed that these flowers must have crossed the Pacific and reached us by travelling westwards, except the marsh-marigold, which seems to have travelled in the opposite direction, and not to have extended hitherto further than Western Asia. The question arises by what route it can have travelled?

The Nematode of Beet-Root.—This little animal, which excites some sensation in countries where the cultivation of beet-root sugar (betose) is carried on, was first observed by Schacht in 1859, whence it is known as *Heterodera Schachtii*. According to the *Zoologischer Anzeiger* the two sexes of this creature differ not merely structurally, but in their development. The females, though possessing a muscular system, are incapable of locomotion and have the shape of a lemon. After fecundation the muscles and the digestive organs gradually disappear, and the entire body becomes merely a protective capsule for the ova. The males, which are larger and of the typical nematodic forms retain their locomotive powers.

WORK FOR NATURALISTS' CLUBS.

In pursuance of the promise given in our last number we shall give some short notes on matters which may profitably occupy a working club. If a leading member, acquainted at least with the elementary works on the subject, will collect and explain the objects specified, an interesting and truly instructive evening can readily be spent.

1. Nectaries of Flowers.—Some botanical text-book, in which fertilisation by insects is described, should be consulted beforehand. Lubbock's "Flowers in Relation to Insects" will do very well.

Buttercup.—Prepare for the microscope a petal of Ranunculus acris, showing the scale at its base. Between the petal and the scale is a drop of sweet juice.

Berberry.—Twelve nectaries, in pairs, lie at the bases of the petals.

Pansy.—Two of the anthers are furnished with long appendages, which pass into the spur. The nectary forms a crowd of eminences upon the upper surface of each appendage.

Yellow Rattle.—A scale, lodging a drop of honey, will be found attached to one side of the base of the ovary.

Grass-of-Parnassus.—Alternating with the five stamens are an equal number of branched nectaries, which in this case are peculiarly modified stamens. Each bears a number of filaments, ending in yellow knobs. At its base is a flat scale, upon which two honey-glands can be seen with an inch objective.

Hyacinth.—The nectaries occupy the spaces between the three carpels. Examine the upper part of each groove with a lens.

These examples illustrate the great variety in position of the nectaries. Other conspicuous and coloured flowers should be searched for similar glands.

2. Some Vegetable Colouring Matters. — Cut up some green leaves with scissors. Boil with water in a test-tube or flask. Add methylated alcohol in place of the water, and boil again. A deep green colouring-matter will be extracted. Observe that this is dichroic, green by transmitted light, ruby-coloured by reflected light on a dark ground. Shake up some of the solution in a test-tube with an equal bulk of carbon-disulphide, and let it settle. The disulphide will slowly separate downwards, carrying with it a dark green colouring-matter. The alcohol will rise to the top, tinged with a yellow colour. Then shake up another sample with twice its bulk of benzine. On separation the alcohol, coloured yellow, will sink to the bottom; the benzine, coloured green, will float to the top. We can thus separate the chlorophyll solution into two constituents, viz., chlorophyllin (dark green) Xanthophyll (yellow).

Treat the colouring matter of yellow flowers (*e.g.*, daffodil) in the same way. A primrose yellow and an orange yellow can be obtained.

Evaporate by means of a spirit-lamp some of the chlorophyll extract. A dark solid substance is obtained. Add water to this. None of the colouring-matter is dissolved. Alcohol, ether, or benzine dissolve it freely.

Take leaves of sorrel, London-pride, Polygonum, or other leaves which show a reddish tint, not due to autumnal fading. Extract the chlorophyll as above, and evaporate to dryness. Add a little water, when a red pigment, soluble in water (Erythrophyll), makes its appearance.

When these simple methods are understood, a great

variety of interesting observations and experiments may be made upon leaves or flowers, which present some peculiarities of colouration.

Some account of the physiological relations of chlorophyll will be found in an article on "The Green Colouring Matter of Plants," which appeared in SCIENTIFIC NEWS, page 85.

THE ROYAL SOCIETY'S CONVERSAZIONE.

IT is customary for the President and Council of the Royal Society to hold two conversazioni each year, the first being in May, when gentlemen only are admitted, and the second in June when ladies are also present. On these occasions an interesting exhibition of the latest scientific instruments is arranged in the spacious rooms of the Society at Burlington House. The first conversazione of this season was held on Wednesday evening, the 9th instant, and was very numerously attended by representatives of every branch of science.

Mr. Wimshurst exhibited his large electrical influence machine, which has 12 discs of 2 feet 6 inches diameter, each carrying 16 metal sectors. This instrument showed large and perfect brush discharges at its terminals, and with Leyden jars gave sparks 13½ inches in length. Prof. Rücker conducted a number of experiments on the optical demonstration of electrical stress. Conductors of various forms are immersed in bisulphide of carbon, and placed between Nicol's prisms. When the conductors are oppositely electrified, the medium is thrown into a state of stress, and the light which had been extinguished by the analysing prism is restored. Captain Abney and Major-General Festing exhibited an instrument to measure the light reflected from coloured pigments.

Mr. Boys made a number of very beautiful experiments with soap-bubbles. By blowing a bubble inside another he showed the power of an air film to prevent the two bubbles from coming into real contact, even if the outer one be pulled out until it squeezes the inner one into a long oval. An inner bubble filled with coal gas carried up to the ceiling an outer one to which was attached a wire ring and a piece of string without really touching it at all. Some of the experiments showed the effects of diffusion, of vibration, and of electricity upon bubbles and groups of bubble. Mr. Boys also exhibited his radio-micrometer, which is the most delicate instrument yet made for measuring radiant heat.

Prof. Judd showed numerous specimens and sections illustrating the recent borings in the delta of the Nile, which reveal some facts of great geological interest. The alternations and mixtures of blown sand and Nile alluvium were found to continue down to the depth of 121 feet from the surface and 95 feet below the level of the Mediterranean. At that depth a remarkable change in the deposits took place, and beds of gravel containing both pebbles and sub-angular fragments of quartzite, chert, compact limestone, with some metamorphic and igneous rocks, were found; and similar beds occur at intervals down to the greatest depth reached. Mr. Gardner exhibited some very fine fossil plants from a small patch of limestone beneath the gravels and silts of an old river course sealed up in the great trap flows of Western Scotland; the Director-General of H.M. Geological Survey showed several maps and diagrams illustrative of the recent work of the geological survey in the north-west Highlands; and Mr. Cadell exhibited some photographs illustrating experiments in mountain building.

Mr. Symons showed a set of thermometers which had been specially constructed for his use in determining the present temperature of the mineral springs in the Pyrenees, and also a number of views in the neighbourhood of these springs, etc. Mr. Chaney exhibited two standard thermometers of the new form approved by the Comité Internationale des Poids et Mesures. These are 700 mm. long, and 28 grammes in weight; they are graduated from 0 degs. to 100 degs. C., and show differences of 0·01 degs. C. Mr. Chaney also showed an exceedingly delicate balance, which will indicate the one-hundred-thousandth part of a grain. Mr. Turner exhibited an apparatus for determining the hardness of metals or other substances. A polished surface of the metal to be tested is brought underneath a weighted diamond, which is moved in such a manner as to produce a visible line on the smooth surface. The weight in grammes necessary to produce a standard visible scratch is taken as a measure of the hardness of the material.

Mr. Shelford Bidwell showed his apparatus for measuring the changes produced by magnetisation in the dimensions of rods and rings of iron and other metals; this instrument being capable of measuring changes of length to a twenty-five-millionth of an inch. An iron rod when magnetised becomes at first slightly lengthened; but if the magnetising force is sufficiently increased it again contracts, and ultimately becomes shorter than when unmagnetised. Cobalt and nickel both contract, while bismuth becomes slightly elongated.

Mr. Norman Locker conducted same experiments illustrating low temperature spectra in connection with the spectra of meteorites, and showed the spectra of magnesium, lead, iron, barium, manganese, etc., at the temperature of the oxy-coal gas flame, and also the conditions of the disappearance of the C and F lines from the spectrum of hydrogen.

Mr. J. M. Richards exhibited Robertson's Writing Telegraph, which transcribes with a pen on a strip of paper at both ends of the line the actual writing of the transmitter, so that both the sender and receiver have a written copy of the message sent. Mr. E. S. Bruce showed his electrical translucent captive balloon for flashing signals by night, which can be used for signalling to long distances, and in places where ordinary signalling would be impracticable.

The Woodhouse and Rawson Electric Supply Company exhibited Mr. Vernon Harcourt's new Pentane Standard Lamp; the Holophotometer, for measuring the intensity of a light all round; and a new carbon Microphone Button for Blake's transmitters. The Schwanschieff Electric Light and Power Company, and the Edison and Swan Electric Light Company both sent specimens of their electric safety lamps for miners.

Prof. Flower showed a skeleton of an Akka, which has been sent by Dr. Emin Pasha for the British Museum. The Akkas, a negro tribe of Central Africa, are the smallest known race of men. The height of the skeleton is exactly four feet.

Among the other exhibits may be mentioned: Specimens of gold and bismuth, showing the effect of small quantities of impurity on the fracture of the metal, by Prof. Roberts-Austen; apparatus for the isolation of the element fluorine, by Prof. T. E. Thorpe; a Coulomb meter, by Prof. G. Forbes; the new iridio-platinum

incandescent gas-burner, by Messrs. Johnson, Matthey and Co.; photographs of flashes of lightning, by the Royal Meteorological Society; model of a maximum pressure anemometer, by Mr. Whipple; charts, showing lines of equal values of the magnetic elements over the globe in 1880, by Staff-Commander Creak; an ants' nest, from Sierra Leone, and also a series of living pictures in insect life, shown on a glass screen, by the aid of a lantern, by Mr. H. Burns; and a system of ballot for members of Parliament, etc., uniting perfect secrecy with a minimum of cost, by Mr. J. Leighton.

At intervals during the evening Dr. Marcet, by means of a camera lens, threw on a screen magnified images of electric sparks from a large electrical influence machine, in order to illustrate flashes of lightning. By means of the new electric lantern Prof. Kennedy exhibited some views illustrating the progress made with the erection of the great steel cantilevers spanning the 1,700 feet wide openings of the Forth Bridge. Mr. A. Sopwith exhibited a number of interesting views, showing the interior workings of a colliery; and Dr. Hickson showed some slides by Mr. Poulton of the true teeth of the Ornithorhynchus paradoxus.

THE SENSE OF SMELL.

SOME remarkable facts have lately been brought forward about the sense of smell. The delicacy of this sense has been carefully tested by a series of very interesting experiments. The whole matter is being investigated on a most extensive scale; but the facts already substantiated are certainly striking.

A series of solutions of each of the following substances was prepared: oil of cloves, nitrate of amyl, extract of garlic, bromine, and cyanide of potassium. Each series was so arranged that every solution was of half the strength of the preceeding one. These series were extended by successive dilutions, till it was impossible to detect the odours. The order of the bottles containing these solutions was completely disarranged, and the test consisted in the attempt to properly classify them by the sense of smell alone. Seventeen male observers and seventeen female observers were selected from the principal apothecaries' shops, and each was required to arrange the bottles. The average of the males detected the smell in the solution of oil of cloves with 1 part in 88,000 of water, whereas the average of the females could only detect smell in the solution with 1 part in 50,000 of water. Nitrate of amyl was detected by the males with 1 in 783,000, and by the females with 1 in 311,000; extract of garlic by males 1 in 57,000, by females 1 in 43,000; bromine by males 1 in 49,000, by females 1 in 16,000; and cyanide of potassium by males 1 in 109,000, by females 1 in 9,000.

A fresh series of experiments of a similar nature was made with other observers on other substances, in order to verify the results. Twenty-seven males were selected and twenty-one females, the substances being prussic acid, oil of lemon, and oil of wintergreen. The solutions were prepared, the bottles disarranged as before, and the observers successively set to the work of classification. The average of the males detected the odour of the prussic acid in a solution of 1 part with 112,000 of water, whereas the average of the females could only detect the smell in the solution of 1 part with 18,000 of water. Oil of lemon was detected by the males with 1 in 280,000, by the females with 1 in 116,000; and the oil of wintergreen by the males with 1 in 600,000, and by the females with 1 in 311,000. Again there was a very great preponderance in favour of the males as to the sensitiveness and discrimination of the sense of smell.

So acute was the sense of smell in two of the male observers that they were able to detect one part of prussic acid in about two million parts of water, and it has no very decided smell, only a strange fustiness. Careful chemical tests failed to show the presence of prussic acid in several of the more dilute solutions in which it was detected by the sense of smell. We remember an experienced druggist who could tell what was in a physic bottle better by the sense of smell than by any other means; but we were never aware, until these experiments were made, that the sense was so acute and discriminating. Two unexpected facts have been established—that males (on an average) are far more sensitive as to smells than are females, and that in some persons it is more discriminating than the subtlest chemical tests.

But a very remarkable case has lately come before us. Dr. Fischer used mercaptan and chlorophenol as the odoriferous substances, and experimented in a room of 9,000 cubic feet capacity. He dissolved 70 grains of each substance in a separate gallon of water. Of the solution of one he took some drops and put them into a quantity of pure water. With a fine jet he directed this solution in a spray to all parts of the room, the air of which was subsequently agitated by the waving of a flag. Experimenters came in by turns and detected the scent. The result arrived at is marvellous. Experts were able to detect the three hundred millionth part of a grain of chlorophenol, and even a thousandth part of that quantity of mercaptan was distinctly recognised.

EXPERIMENT ON SONOROUS CONDUCTIVITY.

A NUMBER of rods of the size of a common lead pencil are prepared from rubber, cork, gutta percha, wood, glass, and steel, and, in order to facilitate the experiment, are united in threes by means of rubber bands, fragments of tubing of the same substance being interposed between them. To perform the experiment, place one end of the rods on a resonant box, and, holding them with one hand, touch their free ends in succession with the handle of a vibrating tuning fork. The sound is not audible when the rubber rod is touched, and becomes louder and louder when the entire series of rods is passed successively in review. By this method, the laws of sonorous conductivity are easily demonstrated, and it is shown that the intensity of sound remains constant, if we substitute one rod for another of the same substance, but of which the length and section vary in the same ratio. On varying the length only, we change the intensity, as we do also when we vary the section and leave the length constant. This method may be employed also for demonstrating the difference in conductivity of wood parallel with and perpendicular of the fibres, and even for determining the numeric ratio of these two conductivities.—*Jour. Russian Physico-Chem. Soc.*

Reviews.

*The Starry Heavens. A Popular Intelligible Astronomy.** (1) By Professor W. Valentiner. Stuttgart: Ferdinand Enke.

Every astronomer is of necessity a mathematician. As such he is under strong temptation to expound his results in mathematical language. This is about as judicious as if an architect, on the completion of a building, should insist on keeping up all the scaffolding, ladders, and other appliances used in the course of the erection. We must therefore congratulate Prof. Valentiner on his having overcome this temptation, and on having given us a survey and oversight of the starry heavens perfectly intelligible to the non-specialist.

He considers in succession the nature of the heavenly bodies—the sun, the moon, the interior planets, the planetoids, the exterior planets—and devotes a special section to the hypothetical planets within the orbit of Mercury. A review of comets and shooting stars, and of the so-called fixed stars, completes the work, which is throughout drawn up with remarkable clearness, and ought to prove acceptable to the educated readers who have neither the time nor the training to become astronomical specialists.

We naturally seek to learn the author's opinions on certain controverted, or, at least, undecided, points in connection with the heavenly bodies. On the question of the possible existence of a planet beyond Neptune, we find no expression of opinion. The existence of an intramercurial planet, however, is thoroughly discussed, with the result that we have no positive evidence of the existence of such a body. An anomaly in the movements of Mercury, not as yet explained, is admitted. But this phenomenon, if, indeed, it be due to the attraction of unknown masses revolving in close proximity to the sun, may be occasioned, not by a single planet, but by a ring-like swarm of bodies, each too small to be detected by us under such unfavourable circumstances.

The supposed discovery of a satellite of Venus is attributed to an optical deception. Attention, is, however, called to the fact that there sometimes occurs on that part of the disc of this planet not illuminated at the time by the sun a development of light concerning which we are still ignorant.

Concerning the origin of the small planetoids or asteroids, circulating between the orbits of Mars and of Jupiter, and now found to be 277 in number, little is said. The supposition is mentioned—at one time entertained—that they may be fragments of a larger planet burst into fragments of some internal force. Another supposition, much cherished by alarmists, was that some unfortunate planet had been destroyed by the shock of a comet. Whenever, therefore, a large comet was seen approaching, the unscientific public were duly warned that a similar fate might overtake our earth, and a scare was the result.

Concerning the supposed influence of comets upon the weather, we find mention of Littrow's elaborate calculation that during more than 150 years the appearance of comets was attended fifteen times with unusual heat, but fourteen times with extraordinary cold. In ten hot years 30 comets were observed, in ten years of mean temperature 21, and in ten cold years 24, so that no influence upon the character of a season can be traced. As to the superstition which regarded comets as harbingers of wars, revolutions, famines, and epidemics, it is interesting to read the opinion of Seneca, here quoted. This old sage, though no astronomical specialist, scouted the notion that a comet was a fire recently kindled. From recent investigations it would appear that of the 300 comets whose orbits have been calculated, 70 only are elliptical and 220 parabolical. Hence the majority of these bodies cannot be regarded as permanently belonging to the solar system, but rather as incidental visitors.

Concerning the probable mass of the larger comets, we find here no statement; but these bodies, of whatever apparent size, are regarded as closely related to the shooting-stars, meteors, or fire-balls, especially as on some occasions many of the last bodies have been seen to draw after them, or to leave behind them, a train of light, reminding us of the tail of a comet.

As regards the so-called "new" fixed stars, the author considers not ten new stars have been discovered with certainty during the past 2,000 years.

Among variable stars, a prominent place belongs to the "star of Tryche," first noticed in 1572 in the constellation of Cassiopoia, and which for a short time was visible even in the day. Its colour was at first white, becoming, as it faded away, yellow, and finally red.

A no less remarkable phenomenon was the appearance of a definite star in the nebula of Andromeda in 1876.

We regret that space does not permit us to follow the author in his account of the double stars, of the nebulæ, and their resolution.

Casting a general glance at the whole work, we must recognise Prof. Valentiner as an eminently judicious and sober-minded astronomer, who contents himself with advancing demonstrable truths, without seeking to amuse his readers with vague conjectures. Hence he will be found a safe and trustworthy guide—a quality that is highly desirable in an age given to rash speculation.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Thirty-first Session, 1887-1888.

Among the papers here inserted we notice the following:—

"On Liquid Fuel," by Mr. James M. Storrar. The author contends that the value of hydrocarbon oils is not, as generally considered twice, but about four times that of coal. Gas of 70-candle power can be produced from the intermediate oils.

The "Application of Electricity to Portable Engineering Tools," by Mr. F. J. Rowan, C.E., is too purely technical a subject for discussion in our columns.

"Collisions at Sea: How to Avoid, and how to Minimise their Disastrous Results," by Mr. Lawrence Hill, is a most important paper. The author mentions that for the last quarter of a century the Board of Trade has taken a retrograde step by consenting to certify seagoing vesssls not divided into water-tight compartments by bulkheads. He shows, in our opinion very conclusively, that the additional cost of these appliances is more than recouped by saving in insurance and by other economies. Mr. Hill specifies a number of causes which either lead to collisions or aggravate their results.

* *Der Gestirnte Himmel. Eine gemeinverstandliche Astronomie.*

Abstracts of Papers, Lectures, etc.

ROYAL INSTITUTION.

At the Friday evening meeting on April 27th, Mr. T. Wimshurst delivered a lecture on "Influence Machines."

The lecturer said that in 1762 Wilcke described a simple apparatus which produced electrical charges by influence, or induction, and following this the great Italian scientist, Alexander Volta, in 1775 gave the electrophorus the form which it retains to the present day. This apparatus may be viewed as containing the germ of the principle of all influence machines yet constructed.

Another step in the development was the invention of the doubler by Bennet in 1786. He constructed metal plates, which were thickly varnished, and were supported by insulating handles, and which were manipulated so as to increase a small initial charge.

In 1787 Carvallo discovered the very important fact that metal plates, when insulated, always acquire slight charges of electricity; following up those two important discoveries of Bennet and Carvallo, Nicholson in 1788 constructed an apparatus, having two discs of metal insulated and fixed in the same plane. Then, by means of a spindle and handle, a third disc, also insulated, was made to revolve near to the two fixed discs, metallic touches being fixed in suitable positions. With this apparatus he found that small residual charges might readily be increased. It is in this simple apparatus that we have the parent of influence machines.

In 1823 Ronalds described a machine in which the moving disc was attached to and worked by the pendulum of a clock. It was a modification of Nicholson's doubler, and he used it to supply electricity for telegraph working. For some years after these machines were invented no important advance appears to have been made, and this may be attributed to the great discoveries in galvanic electricity which were made about the commencement of this century by Galvani and Volta, followed in 1831 to 1857 by the magnificent discoveries of Faraday in electro-magnetism, electro-chemistry, and electro-optics, and no real improvement was made in influence machines till 1860, in which year Varley patented a form of machine designed for telegraph working.

In 1865 the subject was taken up with vigour in Germany by Toepler, Holtz, and other eminent men.

In 1866 Bertsch invented a machine, but not of the multiplying type; and in 1867 Sir William Thomson invented a form of machine which, for the purpose of maintaining a constant potential in a Leyden jar, is exceedingly useful.

The Carré machine was invented in 1868, and in 1880 the Voss machine was introduced, since which time the latter has found a place in many laboratories. It closely resembles the Varley machine in appearance, and the Toepler machine in construction.

The Holtz machine has one revolving plate, the second plate being fixed. The fixed plate is so much cut away that it is very liable to breakage. Paper inductors are fixed upon the back of it, while opposite the inductors, and in front of the revolving plate, are combs. To work the machine (1) a specially dry atmosphere is required; (2) an initial charge is necessary; (3) when at work the amount of electricity passing through the terminals is great; (4) the direction of the current is apt to reverse; (5) when the terminals are opened beyond the sparking distance the excitement rapidly dies away; (6) it does not part with free electricity from either of the terminals singly.

It has no metal on the revolving plates, nor any metal contacts; the electricity is collected by combs which take the place of brushes, and it is the break in connection of this circuit which supplies a current for external use.

The first type of Holtz machine has now in many instances been made up in multiple form, within suitably constructed glass cases, but when so made up great difficulty has been found in keeping each of the many plates to a like excitement. When differently excited the one set of plates furnished positive electricity to the comb, while the next set of plates gave negative electricity—as a consequence, no electricity passed the terminals.

To overcome this objection, to dispense with the dangerously cut plates, and also to better neutralise the revolving plate, throughout its whole diameter, I made a large machine having twelve discs 2 ft. 7 in. in diameter, and in it I inserted plain rectangular slips of glass between the discs, which might readily be removed; these slips carried the paper inductors. To keep all the paper inductors on one side of the machine to a like excitement, I connected them together by a metal wire. The machine so made worked spendidly, and your late President, Mr. Spottiswoode, sent on two occasions to take note of my successful modifications. The machine is now ten years old, but still works splendidly.

The Carré machine consists essentially of a disc of glass which is free to revolve without touch or friction. At one end of a diameter it moves near to the excited plate of a frictional machine, while at the opposite end of the diameter is a strip of insulating material, opposite which, and also opposite the excited amalgam plate, are combs for conducting the induced charges, and to which the terminals are metallically connected; the machine works well in ordinary atmosphere, and certainly is in many ways to be preferred to the simple frictional machine. The quantity of electricity may be more than doubled by adding a segment of glass between the amalgam cushions and the revolving plate. The current in this type of machine is constant.

The Voss machine has one fixed plate and one revolving plate. Upon the fixed plate are two inductors, while on the revolving plate are six circular carriers. Two brushes receive the first portions of the induced charges from the carriers, which portions are conveyed to the inductors. The combs collect the remaining portion of the induced charge for use as an outer circuit, while the metal rod with its two brushes neutralises the plate surface in a line of its diagonal diameter. When at work it supplies a considerable amount of electricity. It is self-exciting in ordinary dry atmosphere. It freely parts with its electricity from either terminal, but when so used the current frequently changes its direction, hence there is no certainty that a full charge has been obtained, nor whether the charge is of positive or negative electricity.

The construction of the Wimshurst machine is of the simplest character. The two discs of glass revolve near to each other, and in opposite directions. Each disc carries metallic sectors; each disc has it two brushes supported by metal rods, the rods to the two plates forming an angle of 90 deg. with each other. The external circuit is independent of the brushes, and is formed by the combs and terminals.

The machine is self-exciting under all conditions of atmosphere, owing probably to each plate being influenced by, and influencing in turn its neighbour, hence there is the minimum surface for leakage. When excited the direction of the current never changes; this circumstance is due probably to the circuit of the metallic sectors and the make-and-break contacts always being closed, while the combs and the external circuit are supplemental, and for external use only. The quantity of electricity is very large and the potential high. When suitably arranged, the length of spark produced is equal to nearly the radius of the disc. I have made them from 2 in. to 7 ft. in diameter, with equally satisfactory results.

BRADFORD NATURALISTS' SOCIETY.

At the fortnightly meeting, held on April 23rd, the President, Mr. J. Clayton, in the chair, Mr. W. D. Roebuck, F.L.S., delivered a lecture on "The Genus Arion." After referring to the distinctions which separated this genus from the other genera of slugs—viz., that in them the shell was rudimentary, the shield granulated and not striated, the breathing-hole at or before the middle of the shield, and the back devoid of keel—he proceeded to speak of the species which compose it, and how they may be distinguished from each other. He stated that all existing English text-books were unreliable, the various species being much confused in them. The researches of Mr. Taylor and himself during the past few years, aided as they were by the anatomical skill of Mr. Charles Ashford, of Christchurch, Hants, and the kindness of innumerable conchologists in all parts of the country in furnishing specimens for study, had succeeded in establishing, on anatomical and therefore satisfactory grounds, the existence of four species as British, in lieu of the three described by Dr. Jeffrey's classical book. The four British species of Arion are *A. ater*, *A. subfuscus*, *A. hortensis*, and *A. bourguignati*. Of these the second and the fourth are quite new as British, and it is only *A. ater* and *A. hortensis* which survive of Dr. Jeffrey's three species. His third species, *A. flavus* is a mythical creature—a mere name, compounded of juvenile examples of the other species, especially of *A. ater* and *A. subfuscus*. The diagnostic characters of each species were then entered upon, and notes on their habits, food and life history, their colour and variation were given. *Arion ater*, which in its most common form is so well known as the "Black Slug," is the largest species of the genus, extremely variable in shade, being found of nearly all colours from intense black, deep brown, warm brown, ochre, yellow red, slate, etc., to creamy and sometimes nearly pure white. It is very distinguishable from the others, not only from its large size and its uniformity of colouring as an individual, but also by its timidity and its being the only one which can be made to contract into a globular or hemispherical shape when at rest, the others being always more or less cylindrical when in a state of contraction. This species is very widely distributed and common, and ascends to the summits of our highest hills. It feeds mostly upon vegetable matters, but is omnivorous and often carnivorous in its diet. Its period of life is about a year, from one autumn to another. An abstract of Dr. Simroth's observations on its colouring matter was given. He finds that there are only two colouring matters, a black pigment and a red pigment, which, mingled in varying proportion, produce all the varying shades of colour exhibited by the species. He finds, further, that relative development of red or black pigment depends upon the temperature at the season of growth, and that each colour is protective, that the black fortifies the constitution against the extremes of heat and cold, and that the red, when developed to an extent which makes the animal conspicuous, makes it also so repulsive in taste and smell that birds will not touch the brilliant red Arions which tourists know so well in the Black Forest. *A. subfuscus* was illustrated by a fine living specimen sent by Mr. Ashford. It is a middle-sized species, less than *A. ater*, but larger than the others. It is a striped or banded species and has a very limited range of variation, being nearly always of a tawny yellow, more or less inclined to grey on one hand or to orange yellow on the other. It is in diet more particularly a fungus-eater, preferring the large fleshy Agaries and Boleti. It is not so common as the other species, but equally widely distributed. The third species mentioned was *A. hortensis*, or the "Garden Slug," a most appropriate name, for it is not usually found away from cultivated land and human habitations. In gardens it is very destructive, and most insidious in its ravages. It is also very thick skinned and difficult to crush underfoot. It is readily distinguished from our other species by the sole of its foot (that is, the whole under surface of the body), being always more or less yellow, often brilliant orange, while in the other species it is white. The fourth and last species mentioned, *A. bourguignati*, has always hitherto been confounded with *A. hortensis* or regarded as a variety of that species, from which, however, it is abundantly distinct both internally and externally. Of about the same size, it is stouter and broader, not so slender and cylindrical, always paler and whiter in appearance, and never with yellow on the footsole, which is always distinctly white. Its habitat is different, as it lives more in the open country, and is equally widely and commonly distributed.

ANTHROPOLOGICAL INSTITUTION.

At the meeting held on April 24th, two interesting papers were read by Dr. Venn, F.R.S., on "Recent Anthropometry at Cambridge," and by the President, Francis Galton, Esq., on the "Head-growth of Cambridge Students." Both papers dealt with experiments made in the direction of measuring the cubic contents of brain in specially selected classes. At South Kensington the heads of over 9,000 persons were measured, the method adopted being to multiply the maximum breadth, taken from ear to ear, by the maximum length from the frontal sinus to the back of the occiput, and multiply this number into the height of the arch of the head above the orbits of the eyes. The South Kensington group was chiefly selected from a homogeneous class of what may be called the "upper professional classes, well fed, well clothed, and the progeny of parents who had enjoyed similar advantages." Tabulated statements of the statistics so arrived at were shown at the meeting, and with these were compared the recently taken Cambridge University statistics of head-measurement. The relative powers of "pull," "squeeze," breathing power, and the height and weight were also compared, with a result strongly in favour of Cambridge men, on the whole, as compared with the South Kensington group, the figures being as follows:

	Height.	Pull.	Squeeze.	Breadth.	Weight.
Cambridge	68·9	83	87·5	254	153·6
S. Kensington.....	67·9	74	85	219	143

These figures point to the high physical condition of the

educated upper classes, although it was admitted that the average high-honour man has, as a rule, weak sight. Coming to the question of cranium capacity, Dr. Venn divided his group of Cambridge men into three classes. Class A consisted of first-honour and tripos men. Class B contained all other honour men of any class. Class C was composed of ordinary degree, or "poll" men, and the mournful group of "plucked" students. The results arrived at were that Class A had larger heads than Class B, and B in turn had more "brain box" than Class C. The diagrams on the wall, however, showed many marked divergencies from the rule or law attempted to be laid down, and critical exception to the president's "curved lines" of mathematical character were taken by several of the speakers in the debate that followed the papers. It seems, however, that (1) the high-honour man has worse sight and more brain than his fellows; (2) that, while in the masses the brain ceases to grow at the age of nineteen, in cultivated students it grows to the age of twenty-five; and (3) that the honour man is exceptionally precocious. To prove that brain is a structure which, like muscle, energy, and nerve-force, can be cultivated with success, the average figures of the three classes mentioned were laid down as "rectangular boxes" that would contain respectively (A) 244·56, (B) 237·7, and (C) 237·33 cubic inches of thinking substance. Many exceptions to the rule were alluded to, and it cannot be fairly said that any accurate law relating to the connection between the volume of brain in cubic inches and the power of those inches to create or formularise thought was logically arrived at. The statistics and tables presented were curious, but not convincing. A third paper followed, entitled, "Remarks on Replies by Teachers to Questions respecting Mental Fatigue," in which the President gave examples of the answers he had received from teachers in reply to queries as to "warning symptoms" of mental fatigue in their pupils. They were of the usual character, and included jaded expression, "lack-lustre" eye, restlessness, yawning, lolling, nervous laughter, fits of sneezing, abnormal skin-colour, especially in the tips of the ears, inability to make the tongue obey the will, headache, sleeplessness, and sleepiness, loss of power to spell, to translate, or perform ordinary arithmetical calculations—in a word, all the symptoms that are perfectly familiar to all who have occasion habitually to perform daily mental work. Some curious instances of colour-blindness produced by mental fatigue were adduced, such as the case of a lady school-teacher who found herself painting ivy-leaves in a brilliant orange when exhausted with a day's labour, and saw her blue curtains turn into a dingy yellow. On the other hand, an interesting example of the effect of over-worked brain was shown in the shape of a capital pen-and-ink drawing of an elephant, of distinctly humorous character, produced in a state of somnambulism by a student studying for a competitive examination. He had been talking to his friends on the subject of elephants before retiring to rest, and he woke up in the night at his study table with all his candles lit, the pen wet beside him, and the elephant capitally drawn on a sheet of blue paper that was handed round among the audience. More interesting, however, than the elephant were the sketches of terrier dogs, drawn on the same sheet at right angles to the central design, showing that the paper must have been turned round and a new current of thought introduced into the sleeping intelligence of the subject.

ROYAL HORTICULTURAL SOCIETY.

At the last meeting of the Scientific Committee Mr. Lynch showed some flowers of *Eichornea tricolor*, a tropical aquatic plant from Pernambuco, where it was gathered by Mr. Ridley. The flowers are in erect terminal panicles, each of a rich blue colour, with a small yellow spot on the lower perianth-segment. Mr. Lynch had grown it in a pot submerged to the rim. A discussion ensued as to the culture of these beautiful plants, Mr. Burbidge narrating his method of inducing *Pothos crassipes* to flower. This he does by not allowing the plant to float, but by placing it in a pot on a shelf fully exposed to light, and thus checking its wandering tendencies.

Young stems of *Dipladenia boliviensis* were shown, in order to show the herbaceous stipular outgrowths at the base of the leaf, and which are divided into narrow lobes in a palmate fashion. These, instead of falling off or drying up, become woody, and may serve to aid the plant in climbing from tree to tree.

A paper was read on the "Fertilisation of *Tigridia* and *Hippeastrum*" from Dr. Bonavia, in which he described how bees search for the nectar under each edge of the inner petals of *Tigridia;* but as they do not touch the stamens and pistil they must have discovered the concealed glands through scent, and so rifle the flower, just as ants do, without pollinating it. *Hippeastrum* is fertilised by pollen-seeking bees or bee-like insects in India. One kind of bee balances itself on the wing opposite the tuft of anthers, and then, suddenly making a sort of somersault among them, brushes off the pollen with the hairs of its body, when the stigma gets dusted all over with pollen. A second kind, after balancing itself, by a sudden movement brushes off the pollen with the hairs of its legs. Lastly, a third kind of bee settles on the anthers, scoops out and devours every grain of pollen. After alluding to the fact that some flies are also pollen-eaters, the author suggests that certain humming-birds, provided with feathers on their feet, may possibly be the true fertilisers of *Hippeastrum* in its native country.

In the course of the discussion on the subject it was pointed out that humming-birds hover over the flowers and perforate them with their beaks, and hence that the tufts of feathers on the legs of some of the species are not likely to act as pollen-brushes. Mr. Morris related how in Jamaica the humming-birds, which at first had not attacked the flowers, suddenly began to split the tubes of the *Cinchona* flowers, and thus ensured the fertilisation of the flower. Mr. Burbidge called attention to the fact, that in South America the scarlet runner does not set its fruit, but in this country it fruits freely owing to the bees, which bore through the base of the flower—a curious illustration of a foreign flower rendered fertile by the agency of British bees.

EDINBURGH GEOLOGICAL SOCIETY.

At the ordinary meeting on May 3d, Mr. James Melvin, Vice-President, in the chair,

Professor Claypole, in replying to a communication from the Society, furnished some further material (supplementary of his former paper) in support of his argument that the Falls of Niagara were receding at a more rapid pace than was formerly supposed.

Mr. G. H. Kinahan contributed a note on "Æolian Driftage," in the course of which he dealt briefly with the amount of driftage and denudations due to wind. The

formation of many a perpendicular cliff could, he argued, be easily explained if the true denudant—wind—was given its proper rank as one of the sculptors of the earth's surface. Moisture and heat disintegrated the rock face of the cliff, while wind carried particles miles away, not only to lower but also to higher levels. Many fine sands above a cliff that were supposed to have come from a higher level had come from below, having been carried by the upward eddy curling up over the cliff edge, to be deposited in its shelter. Moreover, wind did not confine itself to the driftage of fine particles, as it was also capable of moving pebbles and stones of a fair size if they were flat and more or less disc-shaped. Wind not only acted as a direct denudant, but it also generated "sand blasts." This was so conspicuous in cities such as New York as to induce public attention. It might also be observed at home, at street corners and other places round which the wind swept, the lower stones being gradually worn away. The under-cut stones at different heights on a hillside puzzled those who believed that water was the only agent capable of under-cutting; while if winds were allowed to be the agent they were easily understood. Mr. Hugh Miller exhibited a collection of pebbles polished by drifting sand, from the deserts of Upper Egypt and Nubia near the first cataract of the Nile. Speaking of under-cut stones dealt with in the previous paper, he said it had been contended that the Sphinx was in all probability a stone that had had its base swept by the wind until it had a more or less animal form, and that the upper part had been sculptured, very little trouble being required in hollowing out the neck.

DUNDEE NATURALISTS' SOCIETY.

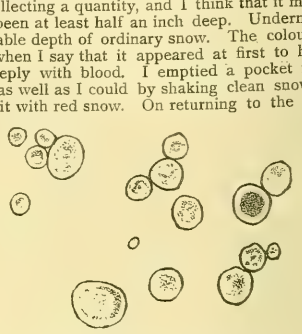
At a meeting of the physical section, held on May 2nd, Professor Ewing (President), who occupied the chair, described and exhibited an apparatus for testing seismometers or earthquake recorders, by means of which the degree of accuracy was determined with which the seismometer responded to and registered the motion of the ground during an earthquake. The apparatus consisted of a lever pivoted by a gimbal joint to a bracket which was fixed to the frame of the seismograph, while the short end of the lever was prevented from moving by means of an independent support. The seismograph was set up on a board mounted on rollers so that it could be made to move about as if an earthquake were in progress. Its own recording lever and the independent lever then traced out, side by side, two diagrams of the motion, and the agreement of these diagrams with one another furnished proof of the accuracy of the instrument. Professor Ewing mentioned that he had been in the habit of using this test since the first construction of his seismograph seven years ago. He exhibited the apparatus in action, and also submitted a large number of pairs of diagrams taken by it. Professor Carnelley then read a paper by Mr. John Alexander and himself on "The Colour of some Carbon Compounds," in which he gave an account of experiments they had recently made as to the circumstances which condition the colour of such compounds, dealing more especially with the effect of temperature, atomic weight, atomic arrangement, and amount of water of crystallisation. Professor Carnelley finally read a paper on the influence of atomic weight and atomic arrangement on the amount of water contained in the crystals of metallic salts of both organic and inorganic acids.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

RED SNOW.

The subject of red snow having been mentioned more than once in your columns, I send you a drawing of the deposit I obtained from a large patch of red snow which I found in Switzerland in August, 1877. During the ascent of the Schilthorn I came across a patch of snow about fifteen to twenty feet long by six to twelve feet in width, forming apparently part of the rest of the snow which covered that part of the mountain. I cannot remember the depth to which the colour penetrated, but there was no difficulty in collecting a quantity, and I think that it must therefore have been at least half an inch deep. Underneath was a considerable depth of ordinary snow. The colour may be imagined when I say that it appeared at first to have been stained deeply with blood. I emptied a pocket flask, and cleaned it as well as I could by shaking clean snow in it. I then filled it with red snow. On returning to the hotel, the



Thousandths of an Inch.

snow had of course melted, and the liquid, which now measured about half an ounce, was of a muddy reddish brown colour. After allowing it to settle, a quantity of the sediment was deposited. The water above was practically clear. I poured this away, having no microscope at hand, and added to the sediment an equal bulk of the best glycerine which I could obtain at Lauterbrunnen, together with two or three drops of carbolic acid. A month or two after, on returning to England, and not having my mounting materials at hand, I took the bottle to Mr. Pillischer, of Bond-street, who mounted several slides. I afterwards mounted about half a dozen myself, and gave them away. Of the two which I have left, both having been prepared by Mr. Pillischer, one only has survived, the other having been attacked by a thread-like growth. The colour has almost entirely disappeared, but the general appearance remains the same. The sediment consists almost entirely of the separate cells of Protococcus Nivalis. This is very similar to the green plant which colours the stems of trees or old palings. One feature has apparently been lost or obscured during the ten years that it has been in my cabinet. Some of the largest cells at one time showed signs of internal division into three to five parts, but I could never satisfy myself that these contained separate nuclei. I believe the mode of propagation of this plant is rather uncertain. I send you the specimen for examination.

There are a few yellowish scales, or shells, whose nature I never could determine. There are hardly any other foreign substances, except in this particular specimen, which contains another yellowish flake with a well-marked pattern on it, and which evidently formed part of some large structure. The other scales give me the impression of having been the complete shells of some animal. A. P. T.

BRITISH LICHENS.

I should feel much obliged if any of your readers could tell me of a book on British Lichens, written in a popular manner.

I want it to enable me to identify any lichens I am likely to find without going into the rarer species. I have looked at two books on the subject at the British Museum—Leighton's Lichens, which seems too technical, besides having no plates, and Lindsay's, which is now out of print, and in which I believe the classification adopted, is now generally discarded. Is there any other book that would suit my purpose, or has the subject been treated in any Natural History Magazine—for instance, Science Gossip? LICHEN.

METEORIC STONES.

On reading in a recent number of your valuable Journal some descriptions of "meteoric stones," I remembered having seen a large one some time ago when inspecting some mines in a remote district in the south of Europe. Its dimensions were more or less as follows: length 2 ft. 3 in. diameter 1 ft. to 1ft 2 in., and its weight must have been more than 10 cwts., as it took three men to turn it over.

With a hammer and chisel I was able to cut off a small bit of it, which appeared like metallic iron; this I afterwards made a qualitative analysis of, and found it contained, besides iron, a good percentage of nickel and traces of cobalt.

The stone was then lying in a farmyard, where I have reason to believe it still remains. It was found some twenty years previous to my visit in an adjoining field when ploughing.

I would feel obliged if any reader of the SCIENTIFIC NEWS could tell me if this stone is of any value. CHAPARRO.

THE ICHTHYOSAURUS.

A discovery of great interest to both the geologist and the student of natural history has just been made in South Somerset. Last week, while some labourers were excavating a pit of blue lias on the Manor Farm, Tintinhull, near Yeovil, they came across a truly magnificent fossil of the ichthyosaurus. From the snout to the end of the vertebra the length was over twenty-two feet, and the jaw, which was furnished with large conical teeth, was nearly three feet long. Three out of the four "paddles" with which the animal propelled itself were very distinct, and all its other structural peculiarities were fully developed in the fossil. Unfortunately, when the clay surrounding it was loosened, the fossil fell to pieces, although one of its most powerful "paddles" (measuring about thirty-four inches long) was preserved intact.

All the fragments, which filled several tubs, were preserved by Mr. Penny, the occupier of the farm, and no doubt an expert in ichthyology would have no difficulty in fitting them together. The spot on which this interesting fossil was found is situated about midway between the Bristol and the English Channels (about twenty-five miles from each other, as the crow would fly), and about two miles from the present bed of the River Parrett, which flows into the Bristol Channel.

Am I correct in saying that no specimen of this curious fish-reptile has before been found on British soil so far away from the sea? Hitherto, the great repository for ichthyosaurian remains has been in the blue lias cliffs at Lyme Regis, Dorset, nearly thirty miles from the spot where the specimen I allude to was found. There are not wanting many evidences to show that the whole of that flat and marshy part of Somerset through which the River Parrett now runs was once an arm of the sea, and at a far less remote time than that which is generally known as the "Saurian period."

GEO. F. MUNFORD.

ANSWERS TO CORRESPONDENTS.

A. R. H.—Sepia is obtained from a black fluid secreted by various species of cuttle-fish, especially by *Sepia officinalis, S. loligo and S. Aunicata.* As soon as possible after capture, the glands are cut off and the fluid squeezed out and dried to prevent putrefactive change from setting in. The pigment is prepared from the black mass so obtained by boiling it with caustic lye, filtering and precipitating the colouring matter by the addition of an acid.

REV. M. BRADSHAW.—The objective glasses you require can be obtained from Mr. J. Browning, optician, Strand.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

PHOTOGRAPHIC PRINTING.—Mr. G. J. Sershall has patented a method of photographic printing. The object is to combine several views on a photograph. This is effected by the use of a series of masks having a transparent portion corresponding in outline to each particular view to be printed on the combined photograph. The rest of the mask is rendered opaque by printing the surface with a suitable ink in a printing press. The printing may be done first, and the required portion of the surface made transparent afterwards by varnish and other suitable means.

PEN.—Messrs. J. Gilmore and W. R. Clark have patented a fountain pen-holder. The invention consists of a device permanently attached to the holder, and which can be used with any class of nib, simply requiring to be cleansed when a new nib is inserted. The device consists of a bent piece of metal which forms a hump upon the back of the pen, but the end of which does not come quite into contact with the nib. The vibration of the pen caused by writing induces an intermittent suction between the end of the bent metal attachment and the back of the nib, which ensures a steady flow of ink to the point. The bent metal must be sufficiently close to the nib to ensure it taking up a supply of ink and holding it by capillary attraction whilst writing.

FIRE EXTINGUISHER.—Mr. J. E. Long has patented a hand fire-extinguisher. The invention relates to extinguishers in which a hand-pump is connected with a portable reservoir, so that the extinguishing fluid may be withdrawn from the reservoir, and projected upon the fire by means of the hand-pump. The apparatus consists of a cylindrical reservoir, which may be conveniently handled by one hand. A hand-pump, having a nozzle, is attached to one side, parallel with the axis of the reservoir, and is adapted to withdraw fluid through a connecting-pipe, and eject it through the nozzle in a stream. In this connecting pipe, between the pump and reservoir, is placed a valvular device, adapted to close the pipe when desired, which device is in the form of a stop-cock, operated by a handle from without.

SAFETY INDICATOR.—A safety indicator for apparatus working under pressure has been patented by Mr. M. Bailey, Peckham. The invention relates to the construction of safety pressure and vacuum indicator for steam boilers and other machinery. A cylinder is employed adapted to be connected to the boiler in any suitable manner, so that its lower end may be open to the boiler. In this cylinder works a tubular piston or a suitable valve; above the piston is a guide chamber, in which is arranged a spring, which is contained within a pressure piston, and this spring can, by means of a screw, be adjusted to the required pressure. By this arrangement, if the pressure in the boiler exceeds the regulated pressure of the apparatus, the annular piston, in rising under the pressure, will compress the spring, and thereby give an alarm in the required place by coming in contact with a suitable electric arrangement

CARBONS.—Mr. P. L. Verchère has patented a carbon. The invention relates to the produce of plates, cells, rods, and other articles of carbon for use in electrical apparatus. It consists in carbonising in a closed furnace sheets of paper or suitable organic materials, which, when reduced to carbon, are cut to any shape or size. For plates of greater thickness, or for cells or other articles of special form the materials employed are reduced to pulp, which is moulded under pressure and then carbonised.

GAS.—An improvement in the manufacture of gas has been patented by Mr. J. H. R. Dinsmore, Liverpool. According to this invention two retorts or sets of retorts are used, one under the other, and preferably placed at an angle from the horizontal. The charge (when coal is used) is placed in the upper retort, and instead of the gas escaping by an ascension pipe in the usual way, it is passed down a pipe to the front of the lower retort, which is the hotter of the two; it then passes to the opposite end of the retort, and rises by an ascension pipe to the hydraulic main or seal, the heavier tar escaping by a down pipe to a well provided for it. By passing the gas through a second retort, the heavier hydro-carbons are more permanently suspended, and so become fixed illuminants in the gas, and by arresting a great portion of the tar before it reaches the hydraulic main, the lighter hydrocarbons will not be absorbed to so great an extent as ordinarily.

ELECTROMETER.—An electrical measuring instrument has been patented by Messrs. Foster of London, and Anderson of Catford Bridge. The invention has relation to that class of measuring instruments in which a movable needle is mounted on an axis perpendicular to the plane of the needle, which, when the instrument is in use, receives an electrical charge, in virtue of which it is acted upon by electrical charges simultaneously communicated to certain stationary parts. This needle thereby acquires a tendency to take up a certain definite position relatively to the stationary parts, which tendency is utilised in various ways for electrical measurement. This invention consists in constructing the movable needle bi-polar, so that it receives simultaneously two charges, one positive and the other negative, and also in arranging this bi-polar needle between two pairs of inductive plates, which are charged simultaneously with the needle by electrical potentials of opposite polarities.

REFLECTOR.—Messrs. F. C. Phillips and H. E. Harrison, of Westminster, have patented a reflector. The invention relates to the class of reflectors in which it is desirable that the reflecting surfaces and the source of light should not be too near each other. A parabolic reflector is combined with a spherical reflector, so that the focus of the parabolic reflector and the centre of the spherical reflector are approximately coincident, the spherical reflector taking the place of that part of the parabolic reflector that lies between its vertex and a plane passing through its focus and perpendicular to its axis, which is the part that would be too near the source of light. The object of the spherical reflector is to reverse the direction of the rays of light that fall upon it, so that they may fall upon the other reflector as though they proceeded direct from the light. A lens is placed in front of the light to give the necessary direction to those rays that would not otherwise be given the proper direction.

TECHNICAL EDUCATION NOTES.

TECHNICAL EDUCATION IN INDIA.—Mr. Alfred Chatterton, B.Sc., has been appointed Professor of Engineering to the college at Madras. The selection was entrusted to a committee, appointed by the Secretary of State for India, which consisted at Sir Alexander Taylor, Principal of Cooper's Hill College, Professor Unwin, of the City and Guilds of London College, South Kensington, and Sir Philip Magnus, Secretary and Director of the City and Guilds of London. The committee recommended two gentlemen, and of these Mr. Chatterton was selected. Mr. Chatterton received his preliminary education at St. Mary's College, Peckham; he subsequently studied at Finsbury Technical College, where, amongst other distinctions, he gained the Cloth Workers' exhibition and numerous medals. Mr. Chatterton's practical knowledge has been obtained at the locomotive works of the London and South-Western Railway at Nine Elms, where he has also been engaged in teaching the apprentices' evening science classes.—*Industries.*

MANCHESTER ASSOCIATION OF ENGINEERS.—At the last meeting of this Association there was a discussion upon technical education. There was a general agreement that some movement in this direction was necessary, but it was pointed out that there was a danger of exaggerating the importance of the subject. It was practically confessed that no system of technological instruction conducted in schools would be satisfactory as a sole means of education, and could only be recommended as an accessory to workshop practice. Eventually a committee was formed to draw up a syllabus of subjects which it was desirable should be studied by youths employed in the workshops.

BLACKBURN TECHNICAL SCHOOL.—The foundation stone of this was laid on the 9th inst. The designs by Messrs. Smith, Woodhouse and Willoughby, of Manchester, have been selected; the estimated cost of the building is £25,000.

THE YORKSHIRE MECHANICS' INSTITUTES.—A deputation from the council of the Yorkshire Union of Mechanics' Institutes, waited upon Lord Cranbrook at the Education Department, Whitehall, on May 8th, to urge upon the Education Department a revision of the Education code with regard to night schools, and the claim of educational institutions which have for so many years undertaken the secondary education of Yorkshire to be recognised by the Government and to have such grants in aid as may appear to be just and expedient. Sir Henry Roscoe, M.P., who introduced the deputation, stated that the union represented 260 institutes in Yorkshire, with 55,000 members, 14,000 of whom were receiving secondary instruction; and half a milllon of money had been raised by voluntary subscriptions for the purpose. The Lord President, in reply, said that the department had not been wanting in a desire to keep up evening classes; but they ought only to be used to supplement the day school and not to be put in its place. The Government were appreciative of the advantages of evening schools, and he hoped something might be done to meet the wishes of the deputation. With regard to the second question, he said that when they got power for local authorities to raise rates for local purposes, he had no doubt but that if local bodies established their technical schools they could with good grace and good reason call upon the State to assist them in what they were doing, and he had no doubt the State would do it. The Government hoped soon to lay the Technical Education Bill of last year before Parliament in an improved form.

TECHNICAL EDUCATION BILL.—The Bill to provide for technical education in England and Wales, prepared and brought in by Sir H. Roscoe, Sir U. Kay-Shuttleworth, Sir B. Samuelson, Mr. G. Dixon, and Mr. A. Acland, has been printed. It provides (1) that any School Board may make provision for giving technical education in any school under their management, and either by day or evening classes, or both, as may seem fit, having regard to the daily occupations of the persons to be benefited thereby; (2) that if no such provision is made, or if it is insufficient, and if the local authority by special resolution determine that provision or further provision ought to be made, they may themselves make

such provision. The Bill also provides for the rendering of aid by School Boards or local authorities to voluntary schools in which technical instruction may be given; and two sections define the conditions under which Parliamentary grants shall be made for the encouragement of such instruction both in voluntary schools and in Board schools. It is proposed that any School Board or local authority, should they think fit, may institute an entrance examination in reading, writing, and arithmetic for persons desirous of attending technical schools or classes under their management, or to which they contribute.

MAIDENHEAD.—A large meeting of teachers and others assembled on Saturday at the Boyne Hill Schools, when Mr. Buckmaster delivered an address on the educational work of the Science and Art Department. A discussion followed, when the following resolution was unanimously adopted:—"That all attempts to teach trades or handicrafts in elementary schools, or night classes in connection with elementary schools, will lead to failure and end in disappointment. A wider extension in elementary science and drawing should be more encouraged as the only true basis of technical education."

ANNOUNCEMENTS.

OWENS COLLEGE, MANCHESTER.—Prof. Arthur Schuster F.R.S., has been appointed to the Langworthy Professorship of Physics and Directorship of the Physical Laboratory at the Owens College.

GERMAN ASSOCIATION OF NATURALISTS.—The sixty-first meeting of this Association will be held at Cologne, from the 18th to the 23rd of September next. The secretaries are Professor Bardenheuer and Herr Th. Kyll.

LONDON GEOLOGICAL FIELD CLASS.—A class for the study of geology in the field, under the guidance of Prof. Seeley, of King's College, is being formed. Further particulars can be obtained from Mr. Nicol Brown, 7, Princess-road, Brownswood Park, South Hornsey, N.

PROPOSED TEACHING UNIVERSITY FOR LONDON.—The Earl of Selborne, Mr. John Thomas Ball, Sir James Hannen, the Hon. George Charles Brodrick, Sir William Thomson, Professor George Gabriel Stokes, and Mr. James Edward Cowell Welldon have been appointed Commissioners to inquire whether any and what kind of new university or powers is or are required for the advancement of higher education in London. Mr. John Leybourn Goddard is appointed secretary to the Commission.

YORKSHIRE PHILOSOPHICAL SOCIETY.—At a meeting on May 3rd, convened under the auspices of this Society, representatives from the museums of Liverpool, Manchester, York, Sheffield, Nottingham, Bolton, Bradford, Sunderland, and Warrington decided that a Museum Association should be formed, consisting of curators or those engaged in the active work of Museums, and of representatives of the Committees or Councils of Management of Museums. The Association will consider (1) whether it may not be possible to secure a compendious index of the contents of all provincial museums and collections; (2) the most effectual methods of facilitating the interchange of specimens and books between various museums; (3) the best plans for arranging museums and classifying their contents; (4) the organisation of some concerted action for the obtaining of such Government publications as are interesting or important from a scientific point of view.

CITY AND GUILDS OF LONDON INSTITUTE CENTRAL COLLEGE.—Arrangements have been made for the following courses of instruction for technical teachers and others during July:—Elementary Principles of Machine-Designing, by Prof. W. C. Unwin, F.R.S.; Practical Lessons in Organic Chemistry, intended mainly for teachers of technological subjects, by Prof. Armstrong, F.R.S.; the Construction and Use of Electrical Measuring Instruments, by Prof. Ayrton, F.R.S.; Experimental Mechanics, by Prof. Henrici, F.R.S.; the Principles of Bread-making, by William Iago; Photography, by Capt. Abney, F.R.S.; Mathematical and Surveying Instruments, by Arthur Thomas Walmisley; Gas Manufacture, by Lewis T. Wright; the Application of Modern Geometry to the Cutting of Solids for Masonry and other Technical Arts, by Lawrence Harvey; and the Craft of the Carpenter, by John Slater.

THE MEDICAL COLLEGES AND SCHOOLS.—Scholarships and Prizes, Winter Session, 1887-88.—London Hospital College: Clinical Medicine Scholarship, Mr. H. E. Skyrme; Hon. Certificates, Mr. W. S. Fenwick and Mr. L. Beckett (equal); Clinical Surgery, Scholarship, Mr. W. S. Fenwick; Hon. Certificates, Mr. H. E. Skyrme, Mr. M. A. Rudd. St. Thomas's Hospital School: The William Tite Scholarship of £30, Mr. J. H. Fisher; the Peacock Scholarship of 40 guineas, Mr. C. P. Lovell; Second Tenure of the Musgrove Scholarship of 400 guineas, Mr. A. F. Stabb; the Mead Medal for Practical Medicine, Pathology, and Hygiene, Mr. H. G. Turney (Messrs. Copeland, Cowen, and Thomas obtained marks qualifying for it); the Cheselden Medal for Surgery and Surgical Anatomy, Mr. F. C. Abbott (Messrs. Boycott and Hulbert obtained marks qualifying for it); College Prizes—first year, £20, Mr. A. Banks; £5, Mr. C. S. Wallace; £5, Mr. C. S. Jaffe—second year, £20, Mr. W. F. Umney; £10, Mr. H. Burden—third year, £20, Mr. A. F. Stabb; £15, Mr. S. G. Toller; £10, Mr. W. G. G. Stokes. St. Mary's Hospital School: the first-year prize of £3 3s. in Anatomy and Histology, Mr. Evans; and that of £3 3s. in Chemistry to Mr. Mander Smythe. The second-year prize of £3 3s. in Anatomy, Mr. L. Rogers; and that of £3 3s. in General Physiology, Mr. Winter; the third-year prizes of £3 3s. in Medicine, £3 3s. in Surgery, £3 3s. in Pathology, and £3 3s. in Operative Surgery, Mr. R. H. Cole. King's College: The Warneford Scholarship of £25 per annum for two years, Mr. Harry Lambert Lack. The Surgical Clinical prizes of £3 each, Mr. Harry Lambert Lack and Mr. Arthur Henry Cheatle.

DIARY FOR NEXT WEEK.

Monday, May 21.—Whit Monday.

Tuesday, May 22.—Birmingham Architectural Association, at 7.15 p.m.—*Class of Construction, Bricklayer, Tiler, and Slater.*
Royal Agricultural Society, at 12 noon.—*Half-yearly Meeting.*
Royal Institution, at 3 p.m.—*Conventions and Conventionality in Art;* by Mr. S. Colvin.

Wednesday, May 23.—Civil and Mechanical Engineers' Society.—*Annual Dinner.*
Cardiff Amateur Photographic Society.—*Theory of Toning;* by Mr. J. Williams.
Bradford Naturalists' Society, at 7.30 p.m.—*Reports of Rambles and Exhibits.*

Thursday, May 24.—Royal Institution, at 3 p.m.—*The Growth and Sculpture of the Alps;* by Prof. T. G. Bonney.
Society of Telegraph Engineers and Electricians, at 8 p.m.—"On his new Standard and Inspectional Electric Measuring Instruments;" by Sir William Thomson.
Camera Club, at 8 p.m.—*Informal Meeting for Discussion of Photographic Topics.*

Friday, May 25.—Royal United Service Institution, at 3 p.m.—*The Equipment and Transport of Modern Armies;* by Colonel H. M. Hozier.
Royal Institution, at 8 p.m.—*Personal Identification and Description;* by Mr. F. Galton.

Saturday, May 26.—Royal Institution, at 3 p.m.—*The Later Works of Richard Wagner;* by Mr. C. Armbruster.
Camera Club.—*Excursion to Dorking and Neighbourhood.*
Physical Society, at 3 p.m.—*On the Governing of Electrometers;* by Prof. W. E. Ayrton. *The Formulæ of Bernouilli and Hacker for the Lifting Power of Magnets;* by Prof. S. P. Thompson. *Experiments on Electrolysis. Part II. Irreciprocal conduction;* by Messrs. W. W. Haldane Gee and H. Holden.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch London.—All letters, Britannia Tool Factory, Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new appliances, metal spinning, milling, etc., in an ordinary lathe; 3s. post free.—BRITANNIA COMPANY, Colchester.

Chisel Steel, 1 to 5 feet bars, ⅝ to 1¼ octagon, 13s. per cwt.—GILBERT, Oxford Road, Sheffield.

Best Cast Steel for tools, taps, and dies, drills, 6d. per lb.—GILBERT, Oxford Road, Sheffield.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Dynamo, 120-candle power, improved armature, 100s. Photo. 5 stamps.—D. WALTON, Hebden Bridge, Yorkshire.

Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps. Castings, lamps, etc.; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s.; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

Meerschaum and Briar Pipes Repaired, Mounted, or cased, ambers fitted.—W. GEORGE, 324, Essex Road, Islington, London.

Fretwork, Carving, Turning, Woods, Tools, and all requisites. Catalogue with 700 illustrations, 6 stamps.—HARGER, BROS., Settle.

Second-hand Lathes, and other tools, offered cheap; on view, Britannia Co., 100, Houndsditch, London.—Send 2 stamps for list, to Britannia Works, Colchester.

"Inventors' and Manufacturers' Patent and Trade Mark Pocket Guide," by G. C. MARKS, C.E., 13, Temple Street, Birmingham. Four stamps.

5in. Burnishers, 7s. 6d.! Silver steel bar, warranted: 6½ in., 12s. 6d.; 9 in., 20s.; 15 in., 40s.—C. C. VEVERS, Horsforth, Leeds.

Photographic Specialities, cheap and good.—Stills, head-rests, backgrounds, washing machines, lamps, shutters, etc. Lists free.—C. C. VEVERS, Horsforth, Leeds.

Mica or Talc cut for all purposes. Mica chimneys, Mica covers, etc.—C. JOHNSON, 87, New Oxford Street, W.C.

Mixing Paints.—A new book containing Trade Recipes, with instructions and details for mixing, making, and using all kinds of paints, oils, colours, etc., free, 1s. 3d.—C. KING, 28, Churchfield, Barnsley, Yorkshire.

A Safe and Effective Benzoline Lamp, 4-candle power, smokeless, 3s. free.—WOOD, Patentee, Blindley Heath, Redhill.

"The **Best Modern Violin** I have seen."—Professor Grattan.—WOOD, Artist, Blindley Heath, *via* Redhill.

Patterns.—100 Fretwork, 100 Repoussé, 200 Turning, 300 Stencils, 1s. each.—COLLINS, Summerlays Place, Bath.

"Dynamo Construction," illustrated treatise, 1s. Price lists dynamo-castings for stamped envelope.—ALFRED CROFTS, Dover.

Named Minerals, Fossils (Carboniferous Lias), twelve, free, 2s. 6d. Polished minerals, from 6d.—C. WARDINGLEY, Blackwood Crescent, Edinburgh.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

Outlines of Geology. By James Geikie, L.LD., F.R.S. An Introduction to the Science for Junior Students and General Readers. With 400 illustrations. London: Edward Stanford. Price 12s.

Three Cruises of the "Blake." By Alexander Agassiz, Director of the Museum of Comparative Zoology at Cambridge, Mass. Fully illustrated. London: Sampson Low, Marston, and Co. In 2 vols., 8vo. Price 42s.

Nature's Hygiene. A Systematic Manual of Natural Hygiene. By C. T. Kingzett, T.I.C., F.C.S., Ex-Vice-President of the Society of Public Analysts. Third edition. London: Bailliere, Tindall, and Cox. Price 7s. 6d.

Antelope and Deer of America. Comprehensive Scientific Treatise upon their Natural History, Characteristics, Habits, Affinities, and Domestication. By John Dean Caton, LL.D. The subjects treated are the American antelope, prong buck, moose, wapiti, elk, caribou, reindeer, Virginia deer, Acapaculco deer, etc. Second Edition. London: W. Wesley and Son. Price 15s.

The Australian Race. Its Origin, Languages, Customs, Place of Landing in Australia, and the Routes by which it spread itself over that Continent. By Edward M. Curr. With map and illustrations. London: Trübner and Co. Price £2 2s.

Granites and our Granite Industries. By Geo. F. Harris, F.G.S., Membre de la Société Belge de Géologie, etc. With Illustrations. London: Crosby, Lockwood, and Co. Price 2s. 6d.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, May 7th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	39·1 degs., being 2·9 degs. below average.	5·5 ins., being 0·7 ins. above average.	241 hrs., being 52 hrs. below average.
England, N.E.	40·2 ,, ,, 3·2 ,, ,,	5·5 ,, ,, 1·0 ,, ,, ,,	229 ,, ,, 40 ,, ,, ,,
England, East	40·5 ,, ,, 4·5 ,, ,, ,,	4·6 ,, ,, 0·8 ,, ,, ,,	224 ,, ,, 117 ,, ,, ,,
Midlands ...	40·9 ,, ,, 3·9 ,, ,, ,,	4·7 ,, ,, 0·3 ,, ,, ,,	202 ,, ,, 99 ,, ,, ,,
England, South	41·3 ,, ,, 5·0 ,, ,, ,,	5·2 ,, ,, 0·9 ,, ,, ,,	209 ,, ,, 129 ,, ,, ,,
Scotland, West	39·9 ,, ,, 3·2 ,, ,, ,,	7·7 ,, ,, 0·9 ,, ,, ,,	277 ,, ,, 19 ,, ,, ,,
England, N.W.	39·9 ,, ,, 4·4 ,, ,, ,,	4·4 ,, ,, 0·2 ,, below ,,	238 ,, ,, 50 ,, ,, ,,
England, S.W.	41·7 ,, ,, 4·8 ,, ,, ,,	6·6 ,, ,, 0·1 ,, ,, ,,	285 ,, ,, 69 ,, ,, ,,
Ireland, North	41·6 ,, ,, 3·5 ,, ,, ,,	6·1 ,, ,, 0·7 ,, above ,,	215 ,, ,, 82 ,, ,, ,,
Ireland, South	43·0 ,, ,, 3·4 ,, ,, ,,	6·8 ,, ,, 0·3 ,, ,, ,,	287 ,, ,, 49 ,, ,, ,,
The Kingdom...	40·8 ,, ,, 3·8 ,, ,, ,,	5·7 ,, ,, 0·5 ,, ,, ,,	261 ,, ,, 71 ,, ,, ,,

The highest temperature observed during the last week of the period was 72 degs. at both Bawtry and Cambridge high a temperature had not previously been observed since the week ending on the 5th of September, 1887.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 21. (*New Series.*) FRIDAY, MAY 25th, 1888. [Weekly, Price 3d By Post, 3½d.

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SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

ON page 438 of this magazine is an account of some of the boulders found in coal seams, and a statement of the ineffectual struggles that have been made to reconcile their existence with the commonly-received notions of the origin of coal. The writer concludes with the wise suggestion that these boulders in coal seams require much further study.

Besides such study of the boulders, I think it very desirable that we should further study the theory which cannot, for the reasons stated by the writer, be reconciled with what we already know concerning the boulders, viz., "the doctrine that beds of coal have for the most part been formed of the remains of trees and plants that grew on the spot where the coal now exists; the land having been successively submerged, so that a covering of mud and sand was deposited upon accumulations of vegetable matter." (Lyell, "Principles of Geology," chap. vi.)

Besides the boulder difficulty there are others equally serious, such as the shells, and the bones, spines, and teeth of fish found in coal, and another even more so. I refer to the quantity and composition of the mineral matter, the incombustible ash, of ordinary coal. To form a seam of coal even three feet thick in the manner supposed, generation after generation of trees must have grown and have left their trunks and leaves to accumulate. The thickness of this loose deposit must have been many times greater than that of the condensed coal; some have estimated it at ten times the thickness, but if only half of this the vegetable accumulation required to form the ten-yard seam of South Staffordshire must have been 150 feet deep. We know that such trees cannot grow upon the mere hydro-carbon of the dead bodies of their ancestors; there must be soil for the roots of each generation, and this soil must be largely composed of mineral matter. Therefore, if the coal were simply the material of the successive generations of forest trees, it must include the mineral matter of the successive soils, over and above that contained in the trees themselves.

Instead of this being the case, ordinary coal contains less mineral matter than exists in any of the plants which most nearly represent the vegetation of the coal measures. The largest proportion of this mineral matter is in the leaves which, being periodically shed, must have constituted more of the vegetable deposit than the trunks.

Moreover, the composition of the mineral matter of the coal is quite different from that of vegetables, which select special constituents from the soil, and incorporate them with their substance, but instead of such selected material, the coal contains only the constituents of the rocks of the period, in rock proportions, not in vegetable ash proportions. (See "Chemical and Physical Geology" by Gustav Bischof.) The total quantity of mineral matter in our ordinary bituminous coal varies from ½ to 2½ per cent. on the total dry material.

If the coal were formed on the spot in the manner supposed, the proportion of vegetable ash would be greatly exaggerated by the fact, that as each year's leaves are shed, their carbon and hydrogen oxidises, and leaves behind a deposit of the special mineral matter assimilated by the leaves, mixed with some humus. The proportion of ash that would thus accumulate may be demonstrated by burning a given weight of dried leaf mould, and comparing its ash with that of the same weight of coal completely burned.

The raft theory suggested by Lyell is open to the same or even greater difficulties; the actual rafts of the great rivers which suggested the theory contain far more mineral matter than coal, and much of it in very gross form—sand and pebbles.

All these difficulties are met by the theory I proposed some years ago—a theory founded on observation of deposits now in actual progress, and now actually forming coal seams on a scale of considerable magnitude. The first of these observations was made in 1855 at the Aachensee, one of the lakes of North Tyrol, situated about thirty miles N.E. of Innspruck.

Its basin is the bottom of a steep valley, the slopes of which are covered with a luxuriant forest vegetation. The water of the lake is singularly clear, so clear that the bottom is visible at great depths, and a curious sight is there revealed. The bottom is covered with thousands of tree trunks most of them lying prostrate, but

a few standing in sloping and nearly upright positions. On looking around, their source is easily discovered. Here and there are long streaks of barren space in the midst of the wooded slopes. These are due to the fall of vegetable avalanches, to hundreds of trees that have been precipitated into the lake and have floated on its surface until soddened with water, and then have sunk to the bottom. The upright position of the few appears to be due to soil and fragments of rock adhering to their roots.

At that time I supposed this to be exceptional, but subsequent observations in Norway proved that at the Aachensee we have only a small sample of what has been taking place on a huge scale in the steep fjords of that country, and which must have occurred far more largely in countries that have had a similar configuration combined with a climate more favourable to vegetation.

In some of the fjords, notably in the Sognefjord and its upper branches, the Slyngsfjord, the Sunelvsfjord, the Nordalsfjord, and the Geirangerfjord, these vegetable avalanches assume great magnitude, and sometimes inflict serious calamities by overwhelming farmhouses, in spite of the fact that the sites of such houses are carefully selected on the best-protected spots, the danger being well understood. The steam-packets that now navigate the above-mentioned fjords afford tourists good opportunity for observing the tracks of such avalanches, which are very plainly and definitely shown.

Though not visible, as in the curiously transparent water of the Aachensee, it is certain that millions and millions of trees must be lying at the bottom of these fjords, as the tree avalanches must have been continually falling during the whole of the present geological epoch. Their leaves were all rotted before the sinking of their trunks, and their potash and other soluble mineral materials washed out during the soddening that preceded their sinking. With a more favourable climate than that of Norway, the quantity would be proportionally greater.

An iceberg floating into such a fjord would, of course, as it melted deposit any stones, large or small, that it carried, and occasionally some of the trees themselves would carry a stone or two entangled in their roots. I have seen such stones thus bound by the roots of fallen trees that have grown on rocky slopes.

The quantity of mineral matter in coal thus formed would depend on the turbidity of the water, and would have the composition of the surrounding rocks, as Bischof shows that of coal to have. The fish spines, etc., are equally accounted for, and also the subsequent covering up of the coal seams by stratified rock. Such covering up is now in progress in Norway, where it occurs without any upheavals or depressions, simply by the gradual outward progress of the suspended matter brought down by the rivers which enter every branch of every fjord, and form what the Norwegians call ören or sandy delta plains, which gradually and slowly advance further and further into the fjord.

I do not suppose that every kind of coal is thus formed; on the contrary, having distilled a few tons of peat, and finding that its hydro-carbons correspond with those obtained from cannel coal and shales, and differ completely from the hydro-carbons of ordinary bituminous coal, I have suggested that the cannel may be an ancient peat deposit *in situ*, while the other has been formed in the manner described, by trees corresponding to those found in the strata above the coal, these latter having fallen at the period when the turbid water was depositing its solid burden which entombed and preserved them.

DOMESTIC ELECTRIC LIGHTING.

WE believe that many people are deterred from having electric lights in their houses because they have an exaggerated idea of the first outlay required, and of the trouble and expense of working the apparatus. We are far from saying that there are not often good grounds for such an idea, when the electrical arrangements are made by unskilled persons who have the most imperfect knowledge of what is best, or when electrical contractors try to compensate themselves for the small number of their contracts by charging an excessive profit on each. Fortunately, there are some thoroughly competent electrical engineers who are well versed in the theory as well as in the practice of their art, and among them, as is well known, may be ranked General C. E. Webber, C.B. This gentleman has made a close study of the simplest and least expensive method of producing electric lights on a small scale for domestic use, and he has lately fitted up his own house, in Egerton Gardens, in a very simple and practical manner. General Webber has been kind enough to let us inspect his house, and has given us particulars of his electrical plant, and of the cost of working it; and with his permission we have pleasure in making the result known to our readers, as the data given may be thoroughly relied on.

For the motive power there is a vertical 1½ H.P. (nominal) Otto gas-engine of the latest type. This engine drives a small dynamo of the AA2 Victoria Brush type, having an output of about 950 watts. The dynamo charges a battery of 13 L size accumulator cells, such as are shown in Fig. 1 made by the Electrical Power Storage Company. The whole of this plant is very compactly and conveniently arranged in a cellar under the pavement, the actual ground space required being only 27 feet long by 5 feet wide. The greatest height is only 6½ feet. The engine is sufficiently well known not to need a special description, but it may be mentioned that all noise from the exhaust is avoided by letting the products of combustion pass into a pit about 3 feet in diameter by 6 feet deep, filled with broken bricks, and thence up a drain pipe 6 inches in diameter, built in an angle of the wall of the house. A small hand-pump is occasionally used to remove the water derived from the condensed steam which forms part of the products of combustion. As a warning to others we may mention that at first this accumulation of water was overlooked, and it caused such a back pressure in the exhaust that the engine could not be worked properly. As soon as the pump was used there was no further difficulty. The dynamo stands on a brick pier 2 feet 6 inches above the ground, so that all its parts are conveniently accessible. The centre of the dynamo shaft is 12 feet from the centre of the engine shaft, and the dynamo is fixed to an adjustable frame, so that the tension on the driving belt can be adjusted as required. The speed of the engine is 160, and of the dynamo 1,550 revolutions per minute. The accumulator cells are placed on insulators in trays of sawdust, arranged in two tiers on a wooden stand, accessible from both sides. These cells are of the new type, in which great improvements have been made in the way of connecting the plates. Also there are no longer any glass plates or rubber bands or plugs, and with ordinary care they need very little attention. The E. M. F. of each cell is not allowed to fall below 2

volts, and as that of the current in the house is required at 24 volts, it is sufficient to use 12 cells at a time, the thirteenth being kept in reserve. The E. M. F of each cell is very easily ascertained by the cell tester (shewn in fig. 2) designed by the Electrical Power Storage Company, and fully described in Sir David Salamons' handbook on the "Management of Accumulators." In this apparatus there is a portable voltmeter, and to this are attached two wires fastened to a wooden rod, which has roughened brass tubes fixed on it at each end, the middle portion of the rod being insulated. When used the rod is simply laid across the cell with one hand, whilst the voltmeter is held in the other and observed, each brass tube resting on a lead strip. The specific gravity of the acid in the cells is ascertained by the usual acidometer (shewn in fig. 3).

FIG. 3.—ACIDOMETER.

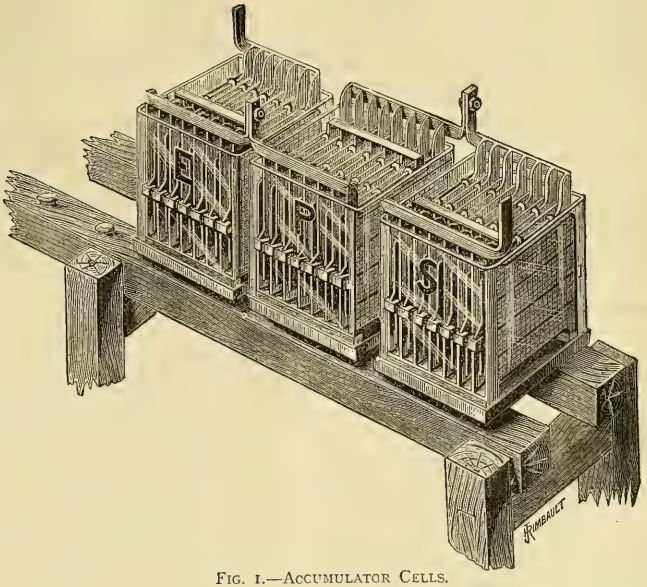


FIG. 1.—ACCUMULATOR CELLS.

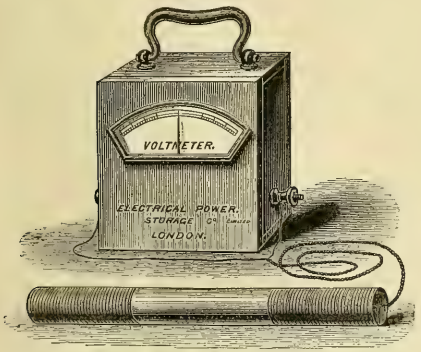


FIG. 2.—CELL TESTER.

A record of the readings of the voltmeter and of the acidometer, as well as of the gas meter attached to the engine, is entered in a book at the beginning and end of each day's charging. A little practice renders the whole process extremely simple, especially as the colour and condition of the acid and plates can be clearly seen through the glass cells.

The chief feature of novelty in General Webber's arrangements is, that all his glow lamps are of only 5-candle power each. In this way he can get great subdivision of light with an economical consumption of current. There are 62 points in the house, to most of which moveable lamps can be connected by short flexible cords, but the average number of lamps in use at one time is only about 20. To prevent over-discharge of the accumulators, not more than 30 lamps should be lighted at once, and near the accumulators is an automatic discharging cut-out, which, instead of cutting off the current, rings a bell in the house if more than 30 are in use. Since October last it has been sufficient to charge the cells twice a week from 8 to 10 hours on each occasion, with one extra day's charging when the discharge has been abnormal. An intelligent lad, who is paid 3s. for each actual day's working of the plant, has sole charge of the whole. As a precaution, there is an automatic cut-out made by the Electrical Power Storage Company, which cuts off the dynamo from the

accumulators, and which can also be set to ring a bell in the house in the event of there being anything wrong during the process of charging. The switch board is fitted with a simple crank switch for cutting out of, or putting in circuit, 11, 12, or 13 cells. There is also an ammeter for measuring the charging and the discharging currents. When the cells are first charged, they usually take a current of 34 amperes by 28 volts, and when their back electromotive force is at its highest, the charging plant is able to put into them a current of 30 amperes by 25 volts. It has been found that during the 6 months from October to March the lights were used an average of 6 hours, and it is expected that during the remaining 6 months they will be used an average of 4 hours each day.

The actual cost of the whole of the generating and storing plant delivered and fixed was £266, and this comprises the following:—

Engine, piping, belting, exhaust pit, etc.
Dynamo, with adjustable base and foundation.
Accumulators and testing apparatus.

In the winter half-year, the *weekly* working cost of 840 lamp-hours (20 lamps × 42 hours) is as follows:—

	£	s.	d.
Gas for engine (20 hours)=1,400 cubic feet, at 2s. 9d. per 1,000 cubic feet	0	3	10
Attendant—two days at 3s.	0	6	0
Renewals of lamps, allowing for 20 lamps to be renewed once a year ..	0	1	10
Oil, belting and sundries..	0	1	0
Depreciation at 10 per cent. per annum on £266	0	10	3
Interest at 5 per cent. per annum on £266	0	5	1
	£1	8	0

For the summer half-year the *weekly* working cost of 560 lamp-hours (20 lamps × 28 hours) is estimated as follows:—

	s.	d.
Gas for engine	2	6
Attendant, two days at 2s. 6d.	5	0
Renewals of lamps, as above	1	10
Oil, belting, and sundries	0	8
Depreciation and Interest as above	15	4
	£1	5	4

The total working cost per annum will therefore be as follows:—

Winter half-year..	£36	8	0
Summer ditto	33	14	4
Per annum	£70	2	4

The number of lamp-hours in the winter half will be 21,840, and in the summer half 14,560, or a total of 36,400, and the average cost will be under ½d. per lamp per hour.

The total number of watt hours, at 19 watts per lamp, will be 691,600, or at the rate of 2s. 3d. for each Parliamentary unit.

In the above estimate we have not included the cost of wires and fittings, as these depend so much on individual taste, but it may be assumed that they cost about the same as gas fittings. In General Webber's case they have certainly cost less.

In London, the Gas Companies are obliged to supply gas which gives a light of not less than sixteen standard sperm candles when the gas is consumed at the rate of five cubic feet per hour, in a standard Argand burner, under favourable conditions. With ordinary burners the result is not so good, and approximately it may be assumed that for a five-candle power light the consumption will not be less than two cubic feet, and allowing for fluctuations of pressure and for unsuitable burners being used for so small a consumption, say three cubic feet per hour. If we multiply this by 840 lamp-hours for a winter week, we shall therefore have 2,520 cubic feet, and this at 2s. 9d. per 1,000 cubic feet will cost a fraction under 7s.

From this it would seem that the gas-lights cost only about one-fourth what the electric lights cost. It must not, however, be forgotten, that in all rooms where gas is used regularly, the ceilings must in consequence be washed and coloured frequently, but that the electric glow-lamps cause absolutely no dirt or discolouration. We do not attempt to estimate the harm done by gas to curtains and other decorations, but speaking roundly it appears to us probable that the direct and indirect cost of gas is about the same as of the electric lights. Whether this is precisely so or not, it will be seen that for a capital outlay of £266—exclusive of conductors and fittings—and with an average working cost of £1 6s. 8d. per week, it is possible to enjoy the comfort of perfectly steady lights which do not vitiate the air. The cost will be much less when houses are supplied by electricity from central stations, but in the meantime we are indebted to General Webber and others who have brought the subject of small installations within the range of practical economies.

In conclusion, we may add that an installation of this kind is very instructive from a scientific point of view, especially as a practical illustration of the interchangeability of different forms of energy. The gas in the cylinder of the engine is exploded, and its heat energy is thereupon converted into mechanical energy; this in turn is converted into electrical energy at the dynamo. In the accumulator cells the electrical energy is changed into chemical energy, and again into electrical energy, and finally it is reconverted into heat and light energy at the lamps. In each of these transformations there is, after allowing for waste due to friction and other causes, a definite equivalent for the energy expended. We thus have a very simple and interesting example of the great principle of conservation of energy.

ASPHALT.—Although the experiments made with Professor Dietrich's patent asphalt paving in Berlin, in which the raw material obtained from the deposits in Vorwohl and Zimmer (province of Hanover) were employed, have not proved perfectly successful, the use of this asphalt as a filling for granite and wood paving is rapidly extending. This asphalt, mixed with powdered limestone, has also recently been introduced in buildings for preventing the walls from becoming damp. When the foundation walls have reached the ground level a layer of asphalt, in the form of thin rolled sheets, is applied, and the walls of the building are erected upon this layer, which is perfectly impervious to moisture. The demand for asphalt for various purposes is thus on the increase. To obtain a larger supply, the Egestorff works are now prospecting for new deposits in the neighbourhood of Hanover, and several new shafts are being sunk.—*Industries.*

NEW PHOTOGRAPHIC MAP OF THE PLEIADES.

SOME time ago the brothers Henry discovered, by means of photography, a nebulosity surrounding the star *Maia* in the Pleiades; this nebula was very faint, and was quite invisible in the best telescopes of the Paris Observatory. Shortly afterwards it was seen with the large refractor, of thirty inches aperture, at the Pulkowa Observatory, and when the new telescope of about the same size was erected at Nice, the nebula was seen by M. Perrotin with sufficient clearness to enable him to sketch it.

Since its discovery the photographic process has been greatly improved by MM. Henry, who intend to take negatives of this group of stars every year, with the double view of ascertaining whether any changes have occurred, and what progress they have made in photographing very faint stars.

In constructing the map, the most interesting portion of which we give in our illustration borrowed from *La Nature*, the print taken in 1886 was used, and to it was added the new nebulosities and stars appearing on two negatives taken on the 16th November and 14th December, 1887, the exposure in each case being four hours.

This map shows that considerable advance has been made in the two years. This progress may be attributed to the greater sensitiveness of the plates, and to the more thorough knowledge of the apparatus and photographic processes.

The feeble traces of nebulosity which in 1885 appeared round Maia, Mérope and Electra are now shown as well defined nebulæ, of complex structure, nearly joined to each other: another spreading nebula surrounds Alcyone. None of these details have been seen with the most powerful telescopes.

The most remarkable peculiarity shown in these photographs are two long and very thin filaments of cosmic matter, nearly rectilinear, and apparently affected by the stars they pass. Nothing of the kind exists in other parts of the sky, so far as we know at present, and unfortunately they are so faint that it will be scarcely possible to see and observe them directly.

One of these objects is situated about 23° 41′ N. Declination, and extends from 3h. 37m. 50s. Right

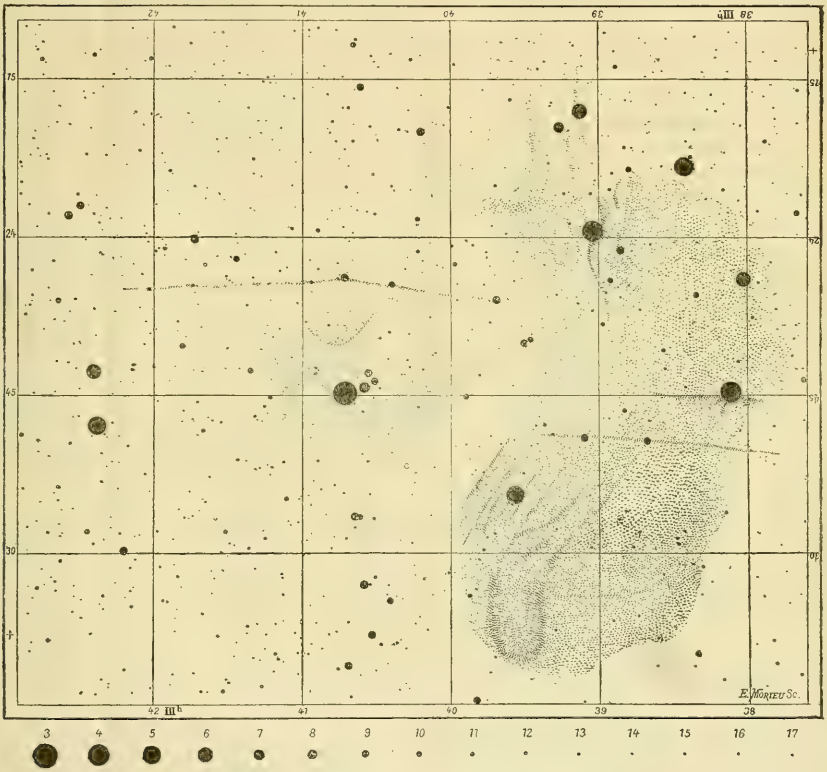


CHART OF A PORTION OF THE PLEIADES GROUPS.
The magnitude of the stars is shown by the size of the circles.

Ascension to 3h. 39m. 30s., crossing amongst other stars numbers 91 and 120 in Bessel's catalogue; the other is in 23° 55′ N. Dec., and appears to reach from R. A. 3h. 39m. 40s. to R. A. 3.h. 42m. 10s., apparently uniting together seven stars.

The map of this region of the sky, made in 1886, contained 1,421 stars, the smallest being of the 16th magnitude; the present map contains 2,326 stars, the smallest being of the 18th magnitude. This shows how greatly the sensitiveness of the plates has been augmented by the attention bestowed upon them.

With longer exposures other details might, perchance, be secured, but at the Paris Observatory the reflected glare from the lamps of the city tends to fog the plate, if the exposure exceeds four hours. In consequence, Admiral Mouchez, the director, is endeavouring to obtain funds to erect a branch establishment at a little distance from Paris.

MULBERRY TREES.

TRAVELLERS in the south of France, who are also familiar with the scenery in China, have been struck by a curious resemblance between the two landscapes. The cause of this similarity may not be at once apparent; but the resemblance is produced by the appearance of the mulberry trees which are grown for the silk industry. The Chinese discovered, after centuries of experience, that a certain height produced the best results. The trees are kept to a height not exceeding ten or eleven feet; this has been found to yield the best crops of leaves, and at the same time affords facilities for gathering them from the branches by means of ladders. When the first silkworms were smuggled from China by two Jesuits in the sixth century, the eggs being hidden in a cane, they brought with them to Constantinople, not only the silkworms, but the complete knowledge of the art of rearing them, and the treatment of the silken produce. The mulberry tree was cultivated in France, in 1564, for this purpose, and not only is its leaf peculiarly adapted as food for the silkworm, but the tree is able to withstand a treatment under which few others would continue to flourish. Two crops of leaves are gathered at intervals of a few weeks, and the vitality of the tree is such that a third crop is put forth. This third supply is left on the tree for the natural purpose of sustaining its growth; but the frugal proprietors, though they dare not deprive the tree for the third time in one season of its organs of respiration, will not permit them to be wasted, and about a week or ten days before they would naturally have dropped off, after having fulfilled their functions, they are gathered for the third time, just as soon as they have ceased to be of use to the tree, but before they have withered. The leaves are gathered in baskets of a large size, and are used as fodder for the cattle, who relish them very much. It would seem that the leaves of some of our trees might be put to the same use, for the cattle eagerly crop the lower leaves of many kinds of trees, and at present they are invariably allowed to drop off to form a very poor manure.

EARTHQUAKE IN MADAGASCAR.—A correspondent of *Cosmos*, writing from Tananarivo, announces earthquake shocks at that town on March 17th, about 8.47 a.m. The weather had been very wet for the three weeks preceeding, the rainfall having exceeded 9 ins.

DISINFECTION.

THE DISINFECTION OF ROOMS.

A CONTRIBUTION to our knowledge of efficient disinfection has been made by Dr. S. E. Crupin, of the Alexander Barracks Hospital, St. Petersburg (Zeitschrift f. Hygiene 3, Bd., 2 heft, 1887).

He used chlorine gas for purposes of disinfection with apparent success until the following incidents occurred, which caused doubts as to its efficacy.

A ward infected with diphtheria, of 900 cubic metres capacity, was disinfected with chlorine gas evolved from the reaction of 50 kilos of chloride of lime and 65 kilos of hydrochloric acid; the ward was well ventilated, and not occupied for seven months. It was then used for the reception of measles for four months. Some of the cases began to show diphtheritic complications; the ward was therefore closed and disinfected with chlorine gas, using to each cubic metre 150 grms. of chloride of lime and 165 grms. of hydrochloric acid. It was disused for seven months, and then opened for the reception of small-pox cases; again diphtheria showed itself, the ward physician, two sisters, and a servant being among those struck down. For the third time the ward was closed and disinfected with chlorine; it was opened again after a few months, and there had been no return.

Laboratory experiments have shown the efficacy of chlorine, but Dr. Crupin thought that the conditions of a laboratory experiment, perhaps, could not be observed in actual practice. To ascertain this he exposed anthrax spores on threads in a ward, and evolved chlorine gas from one kilo of chloride of lime per cubic metre. Upon after-cultivation of the spores, out of seven threads exposed in different parts, the majority were found not to be disinfected at all. He therefore forsook chlorine and experimented with the following solutions:—

1. Corrosive sublimate solution, one per thousand.
2. Carbolic acid solution, five per cent.
3. Equal volumes of both the above.

Experimenting on anthrax spores, he found that the carbolic acid solution failed, that the corrosive sublimate disinfected in the majority of instances, but by far the best result was obtained with the mixture. He therefore advises for the disinfection of rooms, washing and spraying with equal volumes of one per thousand, corrosive sublimate solution and a five per cent. solution of carbolic acid. According to his experience, rooms thus disinfected are not injurious to their subsequent inhabitants. It is noteworthy that he disinfects after pneumonia.—*Public Health.*

PRE-HISTORIC MONUMENTS.—The French Government is giving great attention to the preservation of the cromlechs or dolmens, and menhirs of Morbihan. A commission acting under the Minister of Public Instruction is charged with acquiring them on behalf of the nation.

THE ZONES OF THIBET.—According to General S. J. Walker (*Proceedings Royal Geological Society*) Thibet may be divided into three zones, rising from south to north. The most southern, 10,000 to 12,000 feet above sea level, contains all the towns and villages of the settled population. The middle zone, 12,000 to 14,500 feet high, includes the pasture-lands of the nomadic Bodpas. The northern zone, 14,000 to 17,000 feet in height, is partially occupied by Turkic and Mongol nomads, but is mostly abandoned to wild animals.

General Notes.

Exploration of New Guinea.—Mr. Cuthbertson has ascended Mount Obree, one of the highest summits of the Owen Stanley Range. He finds its height only 8,000 feet instead of 10,460, as determined by the *Rattlesnake* expedition.

Action of Explosives.—Trauzl (*Humboldt*) states that if 10 lbs. of gunpowder be ignited upon an iron plate of 19 millimetres in thickness, the plate is not bent. If ½ lb. of dynamite be exploded upon a plate of 26 millimetres in thickness the plate is perforated, the pressure exerted being more than 10,000 atmospheres.

Meteorites.—Dr Reusch (*American Naturalist*) considers that in the structure of some meteorites we have a direct proof of their orbits being of the same form as those of comets, which alternately approach close to the sun, and again recede. He agrees with Mr. Newton, that "a meteorite is a bit of a comet."

New Falsification of Cod Liver Oil.—According to Prof. Peel, of St. Petersburg, cod-liver oil in Russia is very frequently sophisticated with a petroleum product to the extent of fifty per cent. Neither the colour, the taste, nor the smell betray the fact. But after it has been swallowed the patient perceives a recurring after-taste of petroleum.

Extensive Subsidence.—It is now alleged, though the exact authority is not given, that the northern parts of France, in common with Belgium and Holland, is subsiding at the rate of about 7 feet in a century, and that in twenty centuries, if this rate is maintained, Paris will have completed its last *émeute*, and be resting in peace beneath the ocean.

Hardening Wood.—A process has been patented by M. Stockhardt, of Leipzig, for making ordinary soft wood as hard as *lignum vitæ*, thus rendering it suitable for bearings exposed to considerable pressure. This is effected by first impregnating the wood with oil, and then subjecting it to great pressure, whereby its density is considerably increased.

Apparent Earthquake.—The *American Naturalist* gives an account of a phenomenon occurring at Akron, in the state of Ohio, where several smart shocks occurred in the night of February 10th, cracking the walls of houses and opening long clefts in the ground. The commotion is ascribed not to seismic causes, but to an underground explosion of natural gas.

Exploration in North America.—Dr. Dieck, of Zoeschen, is arranging a scientific expedition for exploring the country along the Northern Pacific Railway. Dr. Roell, of Darmstadt, accompanies the expedition as botanist. The party will set out from Duluth, on Lake Superior, to the Pacific, and will afterwards make a prolonged stay at Deer Lodge, in Montana.

Thibet.—General Prjevalsky will start in August next on his fourth journey in Central Asia. He will be equipped for two years' travel, the ultimate destination of his expedition being Lhassa, the capital of Thibet. The General will be accompanied by an escort of twenty-eight persons, including twelve Cossacks, and two scientific companions, Lieutenant Robrowsky and Sub-Lieutenant Koslow.

Brittleness of Human Bones.—According to Mr. Mason (*Popular Science Monthly*) the increasing brittleness of human bones with advancing years cannot be due to an increasing percentage of inorganic salts, as compared with gelatinous matter. From analyses of the bones of fifty subjects of different ages he finds that after reaching maturity no variation in the quantity of ash takes place with increasing age.

Detection of Margarine in Butter.—M. Dubernard director of the Station Agronomique du Nord, has discovered a process for detecting margarine in butter. The method is based on the fact that margarine at the temperature of boiling water when mixed with a small quantity of a strong solution of ammonia produces a thick froth, while pure butter under the same conditions forms only a few bubbles.

The Cramp of Pianists.—Dr. Vivian Poore (*British Medical Journal*) has observed in pianists certain functional disorder of the arms and hands. He finds that this affection is eight times more common than the well-known "writers' cramp." It is most frequent when the so-called "Stuttgart" method of performance is adopted, *i.e.*, when the wrist is kept immoveable. Cold, a sedentary life, anæmia, rheumatic and gouty tendencies rank as the predisposing causes.

New Ice-Making Machine.—A new patent domestic ice-making machine, of very neat and compact design, has been recently brought before the public. It is known as the "Zero" ice-making machine, and is the joint invention of Messrs. Connacher and Williams. It consists of a double-acting vacuum pump, an acid-resisting enamelled iron absorbing vessel for containing sulphuric acid, and an automatic feed arrangement for admitting in small quantities the water to be frozen.

The Noise of Meteorites.—The sounds which these bodies occasionally produce has been hitherto (*Humboldt*) ascribed to explosion. Daubrée calls this in question on account of the great rarity of such sounds and their peculiar character, which resembled rather the discharge of small arms, the rolling of a train, or the tearing of linen. Hirn shows that it is merely an intensification of the whistling of a bullet. The meteorite moves from 80 to 120 times as rapidly as a bullet, and makes consequently a louder sound.

Effects of Glaciation.—"The faith in glaciers," says Professor Spencer (*American Naturalist*), "as great erosive agents, has been so severely shaken that few geologists who personally study those still existing now attribute to them greater power than that of removing soft materials, and of this power many are sceptical." Herr Paye, who has studied the glaciers of Franz Josef

Land, says: "However diligently I looked for them I never saw unmistakable traces of the grinding and polishing of rocks by glacier action."

Anæsthetics in China.—Says *La Nature*, it is often remarked that all our discoveries, even the most wonderful, have seen the day in China long before they became known in Europe. Thus the use of anæsthetics was familiar in that country before it was taken up by American surgeons. A celebrated Chinese physician living in the 13th century seems to have discovered the use of anæsthetics in operations. He made use of a preparation of hemp which in a few moments rendered the patient absolutely insensible.

A New Opiate.—In the weekly report of the *Berlinische Klinische* Professor Kast, of Freiburg, announces his discovery of a new opiate. He calls it "sulfonal;" it is an oxidation product of the union of "ethylmercaptan" with acetone, it forms crystals without taste or smell, and is easily dissolvable. It has the property of inducing sleep in invalids, particularly in nervous people and those affected with heart-disease, but not in healthy subjects. Professor Kast has observed that "sulfonal" produces sleep without altering the pressure of the blood in any great degree. An accident led to the discovery of the sleep-producing property of "sulfonal." It had been administered to some dogs with quite a different intention, and the animals first were affected as if with intoxication, and afterwards fell into a deep sleep. Experiments made on healthy persons, chiefly physicians, and then on patients in hospitals and lunatic asylums, have proved that "sulfonal" is a harmless and certain means of producing sleep in invalids.

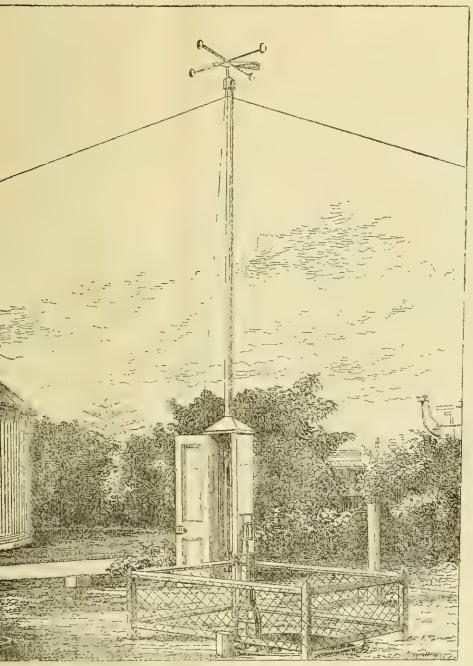
Underground Electric Tramway in Paris.—The Third Commission of the Municipal Council of Paris has under consideration a project of an underground electric tramway to connect several of the chief points of the city. The project, due to M. Berlier, a civil engineer of repute, has been examined and reported on favourably by the engineers in the service of the municipal authorities. Considerable interest is felt in this scheme apart from its public utility, on account of the many novel points involved. There are to be three lines running from the Place de la Concorde, one to the Bois de Boulogne, another to the Place de la Bastille by way of the great Boulevards, and the third to the Porte de Vincennes by way of the Rue de Rivoli. All these lines are to run underground for the whole distance. The tunnel, instead of being constructed of masonry in the usual way, will be formed of a cast-iron tube of circular section and 6m. in diameter. It is proposed to construct these lines without opening the streets at any point. The tunnels, the stations, and the cars are to be lighted by electricity. It is proposed to run, if the traffic requires it, a tram-car every minute, an interval of time amply sufficient to insure safety with the arrangements to be adopted.

The "Challenger" Meteorological Observations.—At a late meeting of the Royal Society of Edinburgh, under the presidency of Prof. Chrystal, a communication was read by Dr. Buchan, the well-known authority, in which he gave an analysis of the meteorological observations made by the *Challenger* expedition during the famous three and a half years' cruise of that vessel. As the meteorological conditions had hitherto been assumed to be the same on land as on the sea, these observations are of the most valuable character, especially since they demonstrate that the above assumption is extremely far from representing the actual state of things. The records, registered for the time stated, show that the mean daily range of the surface temperature of the sea water was only 8-10ths of a degree, and only rose to 1° in one ocean. This Dr. Buchan regarded as one of the most valuable contributions to meteorological science in recent years, and when we remember that even in our own country daily variations of ground temperature to the extent of 30° or 40° are quite common, the opinion will not seem exaggerated. The temperature of the air resting on the sea had a variation three or four times as great as the surface itself, and the humidity simply ran on a parallel with the temperature throughout. Dr. Buchan also discussed at some length the conditions which had been observed to accompany oceanic and electrical phenomena, and afterwards referred to the barometrical observations which he had tabulated, and showed the diurnal variations in wind force at sea, variations which he said were entirely coincident with the temperature. At the same meeting was also read a communication giving a description of the rocks of Malta, and a comparison with deep-sea deposits, by Mr. John Murray, and a paper on a means of ascertaining deep-sea temperatures by an electrical method of reversing the immersed thermometers, by Dr. Chrystal.

Skulls of Three Eminent Composers.—According to *Humboldt*, the Berlin Anthropological Society had recently the opportunity of examining a cast and a photograph of the skull of Joseph Haydn, and photographs of the skulls of Beethoven and of Franz Schubert. Prof. Virchow pronounced these skulls dissimilar, and little in harmony with phrenological notions. Certain peculiarities of Beethoven's skull, that is, the retreating forehead and the projection of the upper jaw with the teeth —prognathism—are less conspicuous if the skull is placed in the position adopted by German craniologists for the purpose of measurement. Still Virchow indicated that the form of the coronal curve of Beethoven's skull agreed with none of the typical forms occurring in central Europe, and that the receding forehead and the strong elevation of the posterior coronal region lie beyond the limits of physiological formations. The magnitude of the back part of Beethoven's skull may probably be viewed as a compensation for the small development of the frontal region. Haydn's skull is of a short and low type, chamaebrachycephalic. Its capacity is 1,500 cubic centimetres, a considerable volume depending principally on the great breadth of the skull. The facial proportions are difficult to estimate, on account of the loss of the teeth. However, the framework of the face must be pronounced broad and low, chamaeprosopic. The nose is strong, prominent, small at the root, slightly concave on the ridge, the nostrils narrow, and very high. The eye-cavities are high, and of considerable circumference. Virchow pronounced the total development of this skull very favourable, and its form typically German. The skull of Franz Schubert, which is distinguished by the beauty of its form, exceeds that of Haydn in volume. That of Beethoven is, according to the determinations executed by Langer, the most capacious of all three.

SIMPLE METEOROLOGICAL INSTRUMENTS.

MR. RUSSELL, of New South Wales, the well-known astronomer, has devised a very simple form of self-recording anemometer, intended for use in country stations in Australia. Our illustration gives a general view of the apparatus. The cups are four inches in diameter, and four feet apart from centre to centre, and they drive a spindle carrying a toothed wheel, which in its turn drives another wheel on a horizontal axis. These wheels are contained in the square box at the top of the pole; the rim of the horizontal wheel is grooved.



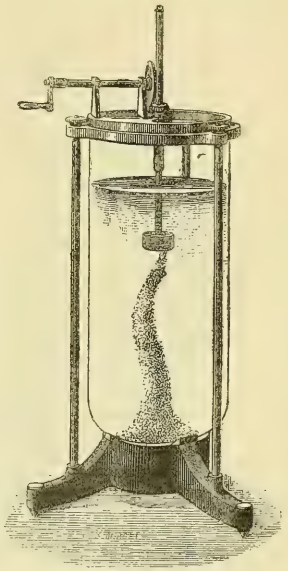
ANEMOMETER AND EVAPORATOR AT THE SYDNEY OBSERVATORY.

An endless wire, kept taut by a weight and pulley in the chamber at the bottom of the apparatus, passes one-and-a-half times round this groove, so that, as the vanes revolve the wire is slowly drawn up. Attached to the lower part of the wire is a carriage which holds the recording pencil, and presses it against a drum driven by clock work. When the carriage reaches the top of the cylinder it must be detached and again placed in position at the bottom, but this only occupies a few seconds.

In front of the anemometer Mr. Russell's apparatus for measuring evaporation is shown. It consists of a galvanised iron tank measuring four feet in diameter and three feet in depth. This is sunk into the ground to the depth of two feet eleven inches, the inch projecting above the ground being left to prevent surface water finding its way into the vessel. Grass is grown round it, flush with the top, for the double purpose of keeping rain from splashing in, and of preventing the sun's rays from warming the outside of the vessel. A light vertical rod, working in guides, is attached to a float, and the amount of evaporation is read off on a scale fixed close to it.

WATER-SPOUTS AND WHIRLWINDS.

A SOMEWHAT prolonged controversy has taken place at the Academy of Sciences between M. Faye and M. Colladon. The former savant declares that he has observed in fluids merely descending rotatory movements.



M. COLLADON'S APPARATUS FOR SHOWING ASCENDING ROTARY MOVEMENTS IN FLUIDS.

M. Colladon maintains that ascending movements occur, and has devised the following experiment to show that such is the case. Into a glass vessel about two feet high, and nearly filled with water, is fixed a wheel, provided with small floats, attached to a vertical axis, which can be rotated at high speed by means of toothed gearing. At the bottom of the vessel is placed some coarse saw-dust previously boiled in water to expel the air. If the wheel be rotated at a speed of four to five turns per second the saw-dust is drawn up in a spiral, and our illustration is reproduced from a photograph taken just as the wood particles reached the wheel. But if we continue to turn at the same rate the water-spout becomes cylindrical, or nearly so.

If we turn much more swiftly the air descends sometimes to the wheel, and we have two spouts, one ascending and the other descending, which struggle and cross

each other. M. Faye declares that whirlpools in water-courses travel. M. Colladon does not believe that liquid vortices have ever been seen in water-courses in their middle or lower parts. We see only the upper part, but in the same river side by side we often see whirlpools which seem to rise to the surface.

Aërial vortices move only when they are in moving air, because they are generally produced by the action of two or three winds of different directions which meet each other.

M. Colladon excepts the case of vortices which are the result of very decided differences in the temperature of the dust on the ground and of the atmosphere. Such will be the case with the dust whirlwinds of Africa, Mexico, and India.

In June, 1887, M. H. Hildebrand forwarded to M. Colladon his interesting memoir on the upper movements of the atmosphere. He appears to share the views of the latter meteorologist, and extends them to tornadoes. He says: "Above a barometric minimum the air moves along the surface of the globe in a form spiral towards the centre, in such a manner that in the northern hemisphere the rotation around this centre takes place in the opposite direction to that of the hands of a watch; near the centre it departs more and more from the axis of rotation; in the upper strata of the atmosphere the air spreads itself out in a uniform layer above the regions of the barometic maximum. M. Dechevrens, Director of the Observatory of Zi-ka-wey, near Shanghai, in China, has studied the typhoon of 1879. The wind, he says, blew towards the centre, which is incontestable. Hence the centre was the seat, in the lower regions at least, of an aspiration and of an ascending movement. Professor Elias Loomis, of Yale College, in the United States, published in 1887 a memoir in which he conceives of alternating cyclones, some ascending and others descending. Professor Colladon has published various observations tending to prove that there are ascending vortices. The following case may be cited: In July, 1887, there occurred one on the Boulevard de la Coulouvrenière, at Geneva, near a place where there were exposed to the sun a great quantity of linen articles of different sizes. Suddenly a whirlwind with a vertical axis passed over the surface covered with linen, which was carried up with a prodigious ascending speed to the height of 600 to 700 metres. These articles were scattered and dispersed in different directions. This was doubtless a whirlwind with an ascending rotary motion.

Boy's Radio-Micrometer.—This instrument indicates differences of temperature of the one-millionth of a degree (centigrade). A very thin rod of bismuth and a similar rod of antimony are soldered together at one end, and connected by a slip of copper at the other. This circuit is suspended by a quartz thread between the poles of a powerful electro-magnet. On an irradiation of the soldered part there is set up a current which, even if very slight, is deflected by the two strong magnetic poles. The apparatus is so sensitive that it indicates the irradiation thrown by a candle upon a halfpenny at the distance of 200 yards.

New Anemometer.—M. Wolf (*Comptes Rendus*) handed in, on behalf of Father Dechoverens, the description of an anemometer for showing any ascending current of air, even if very slight.

Natural History.

POISONOUS FISHES.—II.

The Sting Ray and the No'u.

Equally mysterious are the poisonous properties of the tail of the Sting Ray, which are vested in a long bony spine situated near the base of that member, and armed upon either edge with a series of sharp, cutting teeth, well shown in our illustration which, as well as that of the weever fish given in our last articles, has been copied, by kind permission of Dr. F. Day, from his work on "The Fishes of Great Britain and Ireland." The tail itself is very long and flexible — almost like the lash of a whip—and the method of attack adopted by the fish is to coil the member in question tightly around its foe, and then to lacerate its flesh with the formidable spine, which is worked rapidly to and fro with considerable force. The wound thus caused is in itself sufficiently severe, but is always complicated by symptoms which cannot be caused by the laceration alone, and which point with unmistakable emphasis to the fact that poison of a highly virulent character has been introduced.

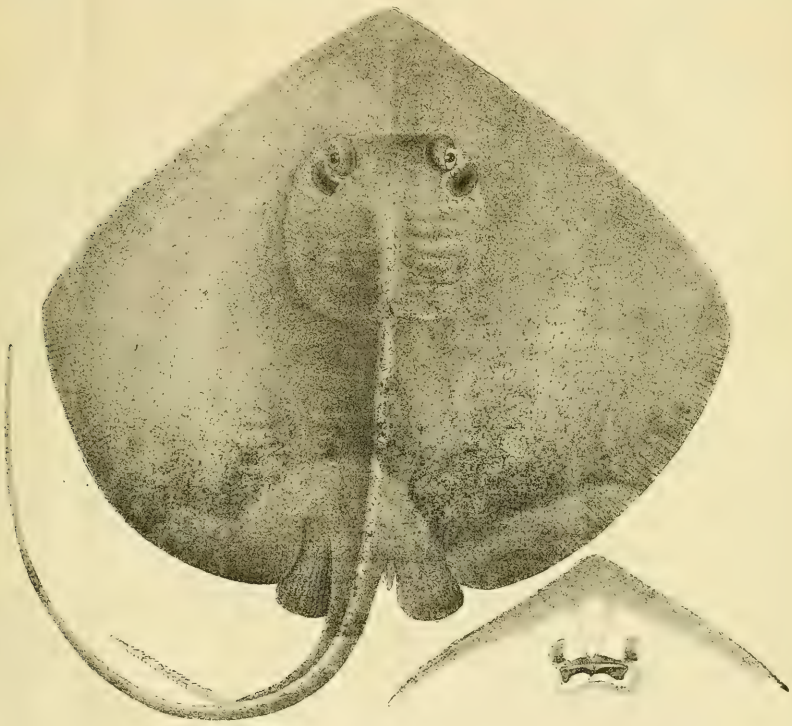
Mr. C. B. Brown, for instance, in his "Camp and Canoe Life in British Guiana," gives a vivid description of the sufferings endured by one of his followers, who contrived to tread upon a sting ray while wading across a narrow stream. The spine passed into the instep of the unfortunate man, producing a jagged wound which bled freely; and although a strong dose of ammonia was at once administered, and the wound itself dressed with laudanum, the sufferer was writhing upon the ground in agony in less than a quarter of an hour, the pain extending, not to the injured limb alone, but also to the groin and to one armpit. A strange symptom was the icy coldness of the leg itself, which was so extreme that the wounded man repeatedly strove to thrust the limb actually into the flames of a fire over which it was supported by a companion. And not for three hours did the pain abate; even then to return at intervals for several days afterwards.

No doubt such an injury to the foot as that described would alone be productive of considerable suffering; but it would not be sufficient to account, in this particular instance, for the extension of pain to the arm-pit and the groin, for the coldness of the wounded limb, or for the great rapidity with which these symptoms were induced. That poison of no little potency was injected into the circulation there would seem no doubt at all. The only question is, Whence did that poison proceed?

And that question we cannot answer. The dissecting-knife reveals to us little or nothing. No poison-secreting glands can we trace, no venom of any sort or description can we find. All we can discover is that which we knew already, that the spine at the base of the tail is the sole instrument employed, and that it does not appear to be in any way adapted to the transmission of a poisonous fluid into the wounds which it inflicts.

Very possibly the weapon itself is its own poison, so to speak, its mere contact with the lacerated flesh bringing about the results described. Such would at least appear from the fact that the bony spine of this remarkable fish is in great request among certain Indian tribes for the purpose of tipping their war arrows and spears, its serrated edges rendering its withdrawal from

the wound far from easy, while its peculiar influence greatly aggravates the injury. Probably a chemical analysis of its constituent elements would set this point at rest. But certain it is, in any case, that the wounds which it causes produce results which can only be due to poison, although the injection of poison does not appear to be involved. The spines of the weever fish, as we have seen, bear a striking resemblance to the fangs of a venomous snake, or to the sting of the scorpion, inasmuch as they are channelled from base almost to point, while their grooves terminate in a small cavity hollowed out at the base. But in the tail-spine of the sting ray we do not even find such a structure as this.



THE STING RAY (TRYGON PASTINACA).

The weapon and the wound which it causes are utterly contradictory. The one appears to be of such a character that the injection of poison cannot possibly be involved in its employment; the other is followed by results which cannot well be due to any other source. And so, for the present at any rate, the investigator is wholly and completely at fault.

We have now seen something of the manner in which certain poison-bearing fishes, such as the weever and the sting-ray, employ their natural weapons for purposes of offence. There are others, however, equally or even more venomous, which act, as a general rule, strictly on the defensive, and never attack a foe unless first interfered with or disturbed. Of these, the most formidable are those creatures which are grouped together under the popular title of "No'u," and of which we may select *Synanceia verrucosa*, one of the most plentiful and widely distributed, as our example.

In this fish the venom-weapons consist of a large number of long and exceedingly sharp spines, which run along the back, and indeed over almost the whole of the upper surface of the body and head. As one author well remarks, they form a perfect *chevaux-de-frise* of defence against all foes. Every one of these spines is a poison-injecting weapon, whose mere prick is inevitably productive of intense suffering, while, should three or four simultaneously inflict their terrible wounds, death is the almost certain result. Such a fate not unfrequently overtakes the natives of New Guinea, and of several of the Pacific Islands. Wading in search of shell-fish, etc., in the shallow water near the shore, they tread upon a No'u lying upon the mud at the bottom, and the mischief is done. There is no hope for the sufferer, who is as surely doomed as if he had been bitten by a rattlesnake or a cobra. The wounded limb rapidly swells until the skin is stretched almost to bursting; the violent pain which immediately follows the wound rapidly extends, first to the body and then to the other members. And, finally, tetanus sets in, and the sufferer dies in terrible

agony. Such a case is recorded by a recent traveller, the victim being a young girl who, incautiously groping in a fissure in the coral, laid her hand upon a concealed No'u, and received the prick of its deadly spines. Although all possible remedies were applied, and every attention paid, nothing could be done even to relieve the pain, and in less than thirty-six hours the poison completed its fatal work.

Sometimes the wounds received are due to pure carelessness upon the part of others. The No'u, for all its venomous properties, is capital eating when stripped of its skin and spines, and forms a very favourite dish with the natives of those coasts upon which it is found. But, with the thoughtlessness so characteristic of savages in general, its captors usually content themselves with flinging the skin, spines and all, into the bush. Now these spines retain all their poisonous qualities for long after death, and the consequence is that any bare-footed passer-by who may happen to tread upon them receives a serious, if not a fatal wound. Yet experience never seems to bring wisdom in its train, and even the wounded man himself, should he chance to recover, will probably repeat the folly in question at the first opportunity.

In the sting-ray and the weever, as we have already seen, the poisonous properties of the spines cannot be traced to any definite source. No venom glands can be detected; no actual virus can be found. But in the No'u the case is altogether different, and at the base of every spine a poison-gland is found, so formed and situated that the slightest pressure upon the weapon in question causes a small quantity of the contents to be discharged through its perforation. And this, or a similar structure, we find in all poison-bearing weapons, whether of reptile, fish, insect, myriapod, or hydrozoon. The actual injection of the virus is in all cases involuntary and mechanical, although the infliction of the wound is not. And it is not uninteresting to speculate upon the origin of the instinct which points out the use of the weapon, while its possessor must yet be perfectly ignorant of the manner in which it will take effect.

In appearance the No'u is very far from attractive, the head and mouth being quite out of all proportion to the rest of the body, while the skin is so loose and wrinkled that, as has been well remarked, it strongly reminds the observer of elephantiasis in its very worst form. In colour it is dark brown, mottled with yellow and red. Hence, while lying, after its manner, perfectly motionless upon the coral, it can scarcely be detected, even by the most experienced eye. Its tints harmonise so well with those of its surroundings, that the prick of its formidable spines is usually the first intimation of its presence; and its resemblance to inanimate objects is even heightened by the fact that the head and back are generally more or less covered with sea-weed. If a coral bed be not forthcoming, the fish lies motionless upon the mud at the bottom, in which it will even bury itself so completely that only the eyes and the tips of the spines project above the surface. To detect it, consequently, save by the sense of touch, is absolutely impossible, and to wade in the waters which it inhabits is a really dangerous undertaking.

When captured, as it frequently is, both by net and by line, the No'u is grasped by the lower jaw, which is quite destitute of spines, and may be handled with impunity. It is quite a small fish, seldom or never exceeding fifteen or sixteen inches in length, of which a very large proportion is occupied by the head. In Tahiti an aspirate is introduced into its name, and it is generally known as the "Nohu."

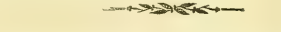
Among the many fish whose flesh is poisonous when eaten, are several of the Tetrodons, of which we have only one British representative, but which are spread over a considerable portion of the world. One in particular, found in Japanese seas, is so exceedingly deleterious that it is commonly eaten as a mode of suicide, producing symptoms very similar to those resulting from an overdose of morphia, and finally causing death. So greatly is the flesh of this fish in demand, indeed, by those who wish to put an end to their existence, that a law exists in Japan forbidding the admission to the army of the son of any soldier who has thus destroyed himself. Yet one or two allied species are perfectly wholesome, and, by the Andaman islanders, others are prescribed for medicinal purposes.

These last, of course, strictly speaking, do not come into the category of "venomous" fishes at all, and they have merely been mentioned in order to draw attention to the fact that actual venom-bearing creatures are generally quite harmless—as is also their venom—when taken internally, while those which produce symptoms of poisoning when taken as food are destitute of venom-bearing weapons. Thus the flesh and the virus of the viper, the rattlesnake, or the cobra may be swallowed with perfect impunity; so, too, may the flesh of the weever or the sting-ray. On the other hand, those fish whose flesh is actually unwholesome, such as the Tetrodons already mentioned, and various Sparoids and *Clupea*, have no poison-weapons at all.

The word "poison," of course, is merely a relative term, as is stated in other language by a certain well-known proverb. That of the viper, for example, produces no effect upon the hedgehog, while rabbits will eat belladonna with evident enjoyment, and without any ill results. And the whole subject is one wrapped in the deepest and most profound mystery. What is there in a fluid, elaborated by a tiny gland from perfectly harmless materials, which shall cause the heart to cease to beat if one small drop be mingled with the blood? Why has it no effect upon its owner, if itself be inoculated with it?

Who can answer questions such as these? The matter is one to fully understand which we must be acquainted with the nature of life itself.

In the case of the fish which possess this singular and mysterious medium, assuredly the most remarkable fact is that in those which use their weapons the most, and for offensive purposes, the actual venom employed cannot be detected at all, while in others which rely upon them almost solely as a means of defence, the secretive glands are both large and distinct. Perhaps some future investigator may be able to account for this anomaly; so far it has received no explanation. And possibly the discovery, if ever it be made, will throw some little light upon the nature and operation of the poison itself, a subject which has so far completely baffled all the researches of the physiologist.



Mother-of-Pearl in the Red Sea.—These fisheries, according to the *Popular Science Monthly*, extend the whole length of the Red Sea, and employ about 300 boats, each having a crew of from five to twelve men. There are two fishing seasons, one of four and one of nearly eight months. The work is conducted only in calm weather, when the shells can be seen at depths of

from 7 to 15 fathoms. Latterly empty petroleum tins, with the ends knocked out and a sheet of glass inserted at one end, have been used to asssist the vision. The glazed end is plunged into the water, when a clearer and deeper view is obtained. The divers enter upon this employment at the age of ten, and continue it to forty years. As a rule they are strong and healthy. During the last ten years the find of shells has been gradually falling off.

Possible Age of Orange Trees.—There is in the gardens of Versailles an orange-tree more than 450 years of age. It was planted at Pampeluna about 1416, by Eleanor of Castille. It was afterwards transplanted to Chantilly and Fontainebleau, and finally to Versailles, in 1684. This case is the more remarkable as the tree has undergone four transplantations, and has never enjoyed anything like its natural climate.

Monstrosities in Beaks of Birds.—Mr. W. B. Tegetmeier (*Field*), gives a number of cases of such deformities. He shows that the beak of a bird grows from the base, like hair or finger nails, and if the balance of growth and wear is not maintained, deformity ensues. Malformation of the beak is sometimes produced by a blow, the bird flying violently against a branch if suddenly startled, perhaps in the twilight, so as to drive the upper mandible down through the lower. A deformed beak may also result from disease.

Alleged Hybrid between the Duck and the Fowl.—Mr. W. B. Tegetmeier, after examining the circumstances of an alleged case of this very improbable hybridity, concludes that the specimens in question were simply instances of malformation.

Phosphorescent Organs of Fishes.—Professor von Lindonfeld, after studying the collections of the "Challenger" Expedition, recognises no fewer than twelve types of these organs, more than one of which may occur on a single fish.

Capture of Moths.—The following method of catching night-flying insects is given by W. V. Reichenar in *Humboldt*:—Behind the left-hand part of a window (the method is applicable only with windows opening like folding-doors) he places a couple of bright lamps and sets the other side very slightly ajar. As soon as any specimens settle on the panes the other side is silently opened and a wide-mouthed bottle containing cyanide of potassium is applied against the glass over the insect; it is then cautiously lifted off, a card or a slip of paper being laid over the mouth.

THE "SERPENT-MOUND" OF OHIO.

NORTH AMERICA retains, as memorials of an unknown past, monuments which cannot be compared to anything existing in the Eastern Continent. These are immense embankments, extending often over entire regions, and certainly intended for defensive purposes. There are further mounds of various forms—conical, square, triangular, polygonal—almost always constructed with mathematical regularity. These last are sometimes places of worship, terminating above in a platform which is reached by an incline, skilfully arranged—sometimes mausoleums—as it is proved by the heaps of human bones which they conceal. At other times, as at Ohilicothe (Missouri), they cover altars of burnt clay, on which are piled thousands of objects of stone, bone, copper, all having evidently been submitted to an intense fire, in the execution of some religious rite.

These mounds appear in incalculable numbers in the valleys of the Mississippi, the Ohio, the Missouri, and their tributaries. They are met with from Lake Ontario, in the North as far as Georgia in the South; from New Jersey in the East to Kentucky and Missouri in the West. Louisiana, the valleys of the Arkansas, and the Red River were peopled by the mound-builders. Quite recently there has been discovered near Carthage, in Alabama, a remarkable group of mounds in the form of elevated slopes, which the plough is unfortunately obliterating day by day.

Some of these mounds attain considerable dimensions. Thus the Labokia Mound is placed in the midst of sixty others, varying from thirty to sixty feet in height, and covering an area of twelve acres. The great mound overlooks all the others; it rises in four successive terraces to the height of ninety-one feet. The base measures 500 feet by 720 feet, and the terminal platform 146 feet by 720 feet. It has been computed that not fewer than twenty-five millions of cubic feet of earth enter into its construction. The mound of Seltzertown is not much less imposing, and that on the river Estowah, in Georgia, was covered with gigantic trees, the successors of others whose existence is proved by their half-decomposed trunks.

It would be easy to mention many other mounds, all affording an exceptional interest. The most curious—and they are not few—are those formed in the shape of animals. In particular, in Ohio and Wisconsin, they may be counted by thousands. Some of them represent mammalia up to sixty-five yards in length, birds whose wings have a spread of thirty-two yards, gigantic reptiles, especially tortoises and lizards, and the other day there was announced from Minnesota the discovery of a spider whose body and legs covered no less than an acre.

One of the most celebrated mounds represents a human figure in such good preservation that it is easy of recognition. According to an old tradition this artificial eminence was erected in honour of a chief killed in battle, whilst a smaller mound, placed between the legs of the figure, was consecrated to the memory of his son, who fell at the same time. We may still mention the lizard in the county of Liking, and a mound near Newport (Ohio) representing an eagle. This latter is situated in the midst of an enclosure surrounded by terraces, known as the Old Fort.

The Alligator of Granville (Ohio) is placed on a mound; each of its legs measures twenty feet in length, the body 255 by 80 feet, the tail 100 feet, and all the members rise from 3 to 5 feet above the level of the ground. An ape discovered in Wisconsin is about 160 feet in length. This is a fact of some importance. No member of the great monkey-tribe is known to have existed, coevally with man, to the North of Mexico. Hence we must infer either that the monkeys must have been found in North America during the human epoch, or else that the mound-builders were familiar with the animal world of Central and South America.

A mound erected near the junction of the Wisconsin and the Mississippi represents so faithfully the form and the proportions of the mastodon that the builders must have known this animal at the very least by recent tradition. The tusks, however, were wanting, being perhaps too difficult to imitate.

The Great Serpent, on a hill overlooking Brush Creek (Adam's County, Ohio), in the midst of a park recently purchased for the Peabody Museum, is a mound in the form of a great serpent. Its coils extend over the length of 1,399 feet; the head is 76 feet in width; the jaws, open to the width of 30 to 40 feet, seem about to seize a mound, the major axis of which is not less than 160 feet. This latter mound has been supposed to represent an egg, and it has been connected with the Egyptian saga of the god Omeph.

The serpent plays a great part in American mythology. It is constantly found engraved upon the earthenware and the ornaments preserved in the Peabody Museum.

In the National Museum, Washington, there is a pipe which represents a man carrying a serpent, coiled round his neck. In the Museum of Mexico is a vase remarkable for the elegance of its proportions, in which serpents form the handles. It is easy to multiply such instances. Serpent-mounds have been lately discovered in Minnesota. The petticoat of Miquitzli, the hideous goddess of death, was formed of interlaced rattle-snakes.

At Mexico, over one of the gates of the Dominican convent, is a bas-relief of great antiquity, in which may be distinguished a serpent crushing a human victim in its folds. Of course, unless this bas-relief is of an earlier date than the Spanish conquest, this relic is of no importance.

At Chichen-Itza colossal serpents are painted and sculptured on the walls of the palace. At Jalapa, in the province of Mexico, may be seen a serpent 15 feet in length engraved upon a rock. The same serpent is found in the bas-reliefs of the Temple of Huitzilopochtli, which dates back to the times of the grandeur of the Aztecs.

The serpent had certainly among the ancient populations of America a mythological meaning which has hitherto escaped us. Was this meaning the same among nations so distinct in their origin and in their manner of life? To this question no precise answer can be given.

The neighbourhood of the serpent-mounds was evidently in request as a place of burial, and explorations undertaken by M. Putnam have brought to light a number of skeletons belonging apparently to very different epochs. Some of these skeletons rested on layers of charcoal, mixed up with large tree trunks entirely carbonised. Around others were found numerous fragments of earthenware and flakes of flint. None of these copper ornaments, so numerous in burial-mounds, appear to have been found here.

To what date can the serpent-mound and the other tumuli representing animals belong? To what race are they due? The answer is doubtful, and the controversies which have been raised are far from being concluded. According to some authorities they are of very high antiquity, and belong to a race which has passed away and emigrated to other regions. Others ascribe to them an origin comparatively modern, and maintain that they are due to the forefathers of the present Red Indians. Neither of these hypotheses is free from serious difficulties.—*La Nature.*

THOUGHTS ON INSTINCT.—I.

"They also reason not contemptibly."—MILTON.

LET us take any routine specimen of the educated classes of the day—or, perhaps, rather of yesterday—and ask him what is the distinction between man and his so-called "poor relations." In nine cases out of ten our educated man will put on an air, half-puzzled and half-consequential, and reply—"well, you see a man has reason and brutes have only instinct." But if we go on to inquire what is instinct, and wherein does it differ from reason, our friend is at a loss, and if disposed to be candid, confesses that "instinct" is a cabalistic word which we use to cover our want of knowledge.

Now, as instinct in its old sense is one of the characteristic and favourite notions of the Old School of Natural History, it will not be time lost if we inquire a little further into the matter.

It is, of course, admitted that all animated beings, at least when mature, show a practical acquaintance with the natural functions of their own voluntary organs. Certain writers, from time to time, profess a very gratuitous wonder that a herring never tries to fly or to burrow in the ground. We should feel much more surprised if the fish in question did make an attempt so out of keeping with the structure and the habits which it has inherited from its ancestors. It is granted on all hands that animals perform certain actions primarily needful for the well-being of the individual or the species. These actions are termed by some (G. H. Lewes) "organic," and by others "instinctive." It is next assumed by authors, though scarcely upon sufficient grounds, that in the lower animals such actions are executed without any previous knowledge, training, or experience; without reflection; without any provision of the results; without any necessary reason or consciousness; and without evincing a "designed adaptation" of means to ends. An additional step is then taken, and we group together all these sections and imagine them as being prompted and guided by some mysterious unitary power or faculty called "instinct"—differing from reason, and yet capable to some extent, of serving as its substitute. Some of the phrenologists even profess to have discovered in the brains of the lower animals an "organ of instinct," not existing in man!

The generality of authors, if they stumble upon this subject, assert that brutes have no reason and man no instincts. Others, like the late Dr. Carpenter, uphold, at any rate, the total absence of reason in all invertebrate animals, "whose whole nervous system may," in their opinion, "be regarded as ministering entirely to automatic action."

Certain questions, therefore, arise here. We must ask firstly for a definition, or in default, for at least an explanation of the term instinct. We then demand by what tests instinctive actions may be recognised and clearly distinguished from such actions as are performed under the control of reason? Admitting, further, the existence of instincts, we ask are they peculiar to the lower animals, or are they shared by the human species?

Definitions of instinct have been attempted, though with no very decided success. A recent writer proclaims that he should "no more willingly attempt to define 'instinct,' than to give an exact definition of insanity." It has been interpreted as: "disposition operating without the aid of instruction or experience;" "mental

power totally independent of organisation;" "power enabling an animal to do that which (in things man can do) results from a chain of reasoning, and in things which man cannot do, is not to be explained by any effort of the intellectual faculties. G. H. Schneider writes: "By instinct we understand the impulse to an action, the purpose of which is unknown to the individual, but which still leads to such purpose."

Professor von Hartmann defines instinct as "purposive action without consciousness of the purpose.

Mr. A. R. Wallace explains it as "the performance by an animal of complex acts, absolutely without instruction or previously acquired knowledge."

Darwin declined attempting any definition of instinct, but he remarks:—"Every one understands what is meant when it is said that instinct impels the cuckoo to migrate, or to lay her eggs in other birds' nests. An action which we ourselves require experience to enable us to perform, when performed by an animal is usually said to be instinctive."

Lastly Mr. Herbert Spencer hits the mark best when he considers instincts as "organised and inherited habits," and again as "compound reflex actions."

The faculty which prompts to instinctive actions is admitted to be mental, nor can we conceive of it as otherwise without we regard animals as automatons. One of the definitions above quoted ascribes to them the power of performing actions such as in man result from a chain of reasoning. If then, certain actions in man are due to a chain of reasoning, why do we not ascribe the same or analogous actions in the lower animals to the same source? To do otherwise, to seek for some unknown and mysterious faculty in order to explain what may obviously be due to reason, is a transgression against the first and second of Newton's "rules of philosophising."

We must remember that many naturalists and philosophers, whilst recognising "instinct" as one of the faculties of the lower animals, have by no means participated in the vulgar error which denies them the possession of reason. Thus Cuvier held that instinct and intelligence are in an inverse ratio to each other, the higher any animal the fewer and the simpler being its instincts. This is the assertion of a gradation where popular prejudice erects an abrupt barrier. He even says of the brutes, "*Leur intelligence exécute des opérations du même genre*," *i.e.*, as those of man. His brother Frederic, keeper of the Zoological Department in the Jardin des Plantes, was led, by his careful and prolonged observations, to similar views. Cicero ascribed to the ant, "mind, reason, and memory." Agassiz held that it is impracticable to draw any definite boundary between the faculties of a young child and those of a young chimpanzee.

By these selections, to which many more might be added, we seek to show that reason and instinct are not necessarily considered as antithetical and mutually exclusive. But some brutes are observed, or at least are supposed, to do things which man cannot perform, and does not know how to set about. For the explanation of such cases "instinct" might be provisionally invoked by sober thinkers as an unknown power.

(*To be continued.*)

Obituary.—The celebrated optician Josef Zentmayer, of Philadelphia, died on March 28th, at the close of his sixty-third year.

Reviews.

Precautions in Introducing the Electric Light. By Killingworth Hedges. London: E. and F. N. Spon. 1886.

We recently noticed an excellently got up book by Fein, which seemed at first to be a manufacturer's catalogue, but which, on examination, was found to contain no allusion whatever to prices. The book before us is of an exactly opposite character. It appears at first sight to be a handbook on the electric light, but it turns out to be a description of the appliances sold by an electrical and engineering company; and more than a quarter of its contents are occupied by a price-list. A book on electrical appliances written or compiled in 1886 must necessarily be somewhat out of date at the present time; but this is no excuse for illustrating as specimens of lamp-holders the two oldest patterns that were ever placed on the market, especially when the very apparent and well-known disadvantages of one of them are fully set forth on page 29. In a book, if book it may be called, dealing in such a marked way with prices, it is surprising to find the statement that "silver has the highest conductivity of all metals, and, if the price continues to decline, it is within the bounds of possibility that it may be used for winding dynamos." The resistance of copper is only four per cent. less than that of silver; the former is a little more than 8½d. per lb.; the latter is a little less than £2 16s. od. per lb.; and the suggestion is little else than nonsense.

In a glossary of technical terms we find several rather questionable definitions. "Magnetism: a condition of electrical action which can be highly developed in iron and steel." "Power [P.]: The rate of doing work when an ampère passes through an ohm. The unit is the Watt." The illustrations also contrast strongly with the German book to which we have alluded. The only fairly good ones are borrowed, together with a considerable quantity of matter, from the catalogues of other firms for whom the company are apparently agents. There is a want for a thoroughly reliable handbook on the subject, and, with careful revision, excision of price list, and brief descriptions of other manufactures than those of one firm only, the author, who has produced several *brochures*, might supply it.

Catálogo de los Coleópteros de Chile, por Federico Philippi. (De los *Anales* de la Universidad de Chile. Tome lxxi. Santiago de Chile: Imprenta Nacional.)

We are indebted to the courtesy of the author for this interesting publication. A catalogue of the 2,254 species of Coleoptera hitherto recognised in Chile may, at first sight, seem very dull and dry. But to the student of animal geography such documents are most valuable materials for a discussion of the laws of animal distribution.

We might naturally expect that the insects of Chile would be a selection of South American forms, such, namely, as were capable of existing in cooler and more arid climates than those of Brazil or Venezuela. Such, in fact, is, to a great extent, the case. But along with the characteristic Neotropical species we find a number which appear to have spread along the Andes, and to be closely allied with the forms of the north temperate zone. Thus we find here *Tetracha carolina*, which is found in various parts of the United States. *Pterostichus*, *Platysoma*, *Steropus*, and *Dromius*, genera common in Europe, have each species in Chile. In this we encounter little diffi-

culty. As many insect forms are common to Northern Asia, Europe, and North America, or, in more technical language, to the Palæarctic and Nearctic regions, and these, as it has been already intimated, may have found the Andes a convenient way to the temperate portions of South America, it may safely be said that, had the whole of intertropical America been always a lowland forest from sea to sea, no such species would have found their way to Chile.

A much more difficult point is the presence in Chile of not a few characteristically Australian forms. The two countries are well known to be separated by the vast Pacific, which we can scarcely assume to have been bridged over by any intervening continent or even by chains of islands. Thus there are four genera of Buprestidæ common to South America and Australia, and not existing elsewhere; and the enormous and characteristic Australian genus, *Stigmodera*, is most closely related to the South American genera, *Conognatha*, *Hyperantha*, and *Dactylozodes*, the latter pre-eminently Chilean. We need, however, the less enlarge upon these subjects, as there is nothing in Professor Philippi's catalogue which at all militates against the views of Mr. A. R. Wallace, in his "Geographical Distribution of Animals."

The only discrepancy between the two authorities is that the catalogue before us specifies no Cetoniadæ as occurring in Chile, whilst Mr. Wallace says that "only a few species of the Neotropical genus, *Gymnetis*, reach Patagonia." Possibly, however, he means that their southward extension takes place on the eastern side of the continent.

A Manual of North American Birds. By Robert Ridgway. Philadelphia: J. B. Lippincott and Co.

Broadly speaking, this work gives us the bird-fauna of the great Nearctic region. The birds of Socorro Island have indeed been included, and also the Mexican, Cuban, and Bahaman species, which belong to, "characteristically, North American genera." The term "Mexican" is extended so as to include even the forms belonging to Guatemala and Honduras, and falling, consequently, within the Neotropical region. Concerning this extension, some difference of opinion may prevail. It might, we think, have been preferable to include in the work only species which have actually been observed within, or very close to, the limits of the Nearctic region. Now, we find here a number of parrots belonging to the genera Ara and Amazona, and occurring in Central and South America. But these genera and the family to which they belong are certainly not North American (Nearctic). Very similar is the case as regards the Trogons, of which six species are described, one only of which (*Trogon ambiguus*) has been found in Northern Mexico, Texas, and Arizona.

The arrangement of birds here adopted begins with the divers, and ends with the passerine group, all, of course, carinate.

The descriptions of the genera and species are necessarily brief, but they may claim the merit of great clearness; and the identification of the various forms will be much facilitated by the 464 outline drawings which show the distinguishing characters of the genera. The dimensions, we are happy to find, are given in English inches and hundredths of an inch, so as to be at once intelligible without the aid of tables.

Colours are named in accordance with a work of the author's on the "Nomenclature of Colours," which deserves to be generally known to naturalists. There are few subjects on which greater confusion prevails.

The work was originally projected by Prof. Spencer F. Baird, of whom we find a kindly and reverential obituary notice. But it is not easy to speak too highly concerning a man of whom it may be said that "every naturalist of eminence in the United States owes much of his success to a personal intimacy with Professor Baird." In almost every respect we may pronounce this book a model for regional fauna in any department, and we feel confident that it will be highly appreciated by all sound ornithologists.

Journal of the Society of Telegraph Engineers and Electricians. Vol. xvii. No. 72.

The principal matter to be found in this issue is a paper by M. Von Treuenfeld, on the "Present State of Fire Telegraphy." The speaker showed that in towns with a perfect fire-telegraph system the serious fires are reduced to an average per centage of 4, with less perfect systems the serious fires reach 17, and in the absence of fire-telegraphs amount to 29. In London the per centage of serious fires has fallen since 1866 from 25 to 7. The number of lives lost per 100 fires has, however, not beeen appreciably reduced. In 1876 it was 2·14 per cent., and in 1886 it was 2·28 per cent.

Neither the speaker nor any of the gentlemen who took part in the subsequent discussion, seems to have borne in mind that rapid communication with the fire-brigade stations, however important, is of little avail so long as the ceremony of finding and bringing the turn-cock has to be gone through. With the constant pressure system a fire has much less chance of getting a firm hold.

The Journal of the Franklin Institute. Third series. Vol. xcv. No. 4. April, 1888.

We find here a continuation of the memoir on "Early Forms of Electric Furnaces," by Professor E. J. Houston. The modifications here described are those of Johnson, and of Watson and Prosser. The paper on M. Moissan's "Isolation of Fluorine" is taken from *Nature*.

Proceedings of the Institution of Mechanical Engineers. February, 1888.

This issue, in addition to the important Presidental Address, contains a paper by Mr. John Richards, on "Irrigating Machinery on the Pacific Coast of the United States," and a summary by Mr. W. Geipel, of the "Position and Prospects of Electricity as Applied to Engineering," in which a great number of interesting facts are brought forward.

NEW BRONZING PROCESS.—A correspondent has sent us the following formula for depositing bronze by electricity:—Add to every 16 ozs. of a saturated solution of nitrate of iron in pure water at 110° F. 1 drm. of a saturated solution of chloride of ammonium and ½ oz. loaf sugar. Stir the whole thoroughly, let it settle, and after four hours decant the solution into the plating vat or vessel in which are suspended the articles to be bronzed. At first use a current of 4 volts, which will produce in less than two minutes a spongy coarse-grained deposit of a rich black; scratch-brush the articles and replace in bath, reducing the current to 1½ volts, when a rich steel bronze colour will soon be produced. After from five to ten minutes the articles are taken from the bath, passed through a hot solution of hypo-sulphite of soda, and then through clean nearly boiling water into boxwood meal, when they are ready either for scratch-brush, relieving, burnishing, or lacquering.

Abstracts of Papers, Lectures, etc.

THE ROYAL INSTITUTION.

THE Friday evening discourse, on the 11th inst., was given by Professor W. Chandler Roberts-Austen, on "Some Curious Properties of Metals and Alloys." He first alluded to the work of chemists, at the end of the last century and the beginning of this, in observing changes in the behaviour of metals when two or three were chemically combined. Berthollet's great paper of 1803 was especially referred to as a starting point for future work. Hatchett, also, was not forgotten in the historic retrospect. It gradually came to be seen that a body, whether called simple or compound, might have the same chemical composition, and yet might have very different physical properties. We have learnt that in organic compounds this is notably the case. Chemists have adopted the word "isomerism," or the phrase "allotropic condition" for the recognition of this fact, a fact that as yet is without explanation. The idea is that it is the molecular grouping of the chemical atoms that is different. As an illustration mention was made of nicotine and piperine, both chemically alike, yet one has the physiological effect of lulling into sleep and the other of arousing from sleep. At present, different grouping is the only hypothetical explanation. In metals combined together there appears to be what under old views would be called unexplained anomalies. A mixture of tin and arsenic cannot be distinguished from ordinary zinc. The study is not one solely of theoretic interest, it has its practical aspects. A very slight change in a metal makes all the difference between its being useful or not, or even injurious. Chemists have too much neglected "isomerism," or, if the word be preferred, "allotropism." From 1849 to the work of Schutzenberger, in 1878, but little was done. Tin as manufactured will behave very differently at different temperatures. Some military buttons sent to St. Petersburg crumbled to dust in the cold there. Some interesting experiments with globules of gold were shown in illustration of the effect of temperature. Joule had shown that iron liberated from an alloy was very different from ordinary iron. Aluminium, again, does not much suffer from oxidation, nor does mercury, yet an alloy of the two does, a fact illustrated by experiment. Bismuth, tin, and lead may be mixed, as was shown, without much change of temperature. The addition of mercury brought the mixture to freezing point. Alluding to the practical use of such studies, the lecturer mentioned that copper used for telegraphy was now manufactured in a different way from what it used to be. The result was that electricity could be passed at twice the rate that it could with the old impure copper, which practically meant that double the number of messages could be sent in an hour. The presence of "impurities"—*i.e.*, foreign bodies in metals—also affected their tenacity. This was illustrated by bars of pure gold, and bars with 2-10 per cent. of lead. The pure gold stood from 16 to 17 tons per square inch, while the alloy gave way at an almost nominal pressure. The mixture of chromium and iron was mentioned as a most important consideration in connection with our national defences. Many experiments in gunnery were alluded to, in which the mixture of different small quantities of chromium with lead had been tested.

IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute took place on May 9th and 10th, the President, Mr. Daniel Adamson, in the chair.

Mr. J. S. Jeans, the Secretary of the Institute, submitted the annual report. The number of members at present was 1,313, and 72 candidates were awaiting election. Among the 27 members who had died during the past year was Sir Joseph Whitworth. The Council had determined to accept the invitation which had been received to visit the United States in the autumn of next year. The next autumnal meeting would be held at Edinburgh. The Prince of Wales had consented to become an honorary member of the Institute.

The Council having unanimously resolved to present the Bessemer gold medal for the present year to Mr. Daniel Adamson, the President of the Institute, as an acknowledgment of his valuable services in the early application of Bessemer steel to engineering purposes, and of his no less valuable researches into the physical and mechanical properties of metals, the presentation was made by the donor, Sir Henry Bessemer.

The President, in acknowledging the honour done him, gave some interesting personal particulars of his connection with the application of Bessemer metal, and stated that at his own works at Manchester nothing else was used. The production of pig-iron in the United Kingdom, in the United States of America, in Germany, and the leading States of Europe, which may be considered the world's output, amounted in 1887 to 21,832,663 tons as compared with 19,818,100 tons in the previous year. The total production of manufactured iron in the United Kingdom was 2,237,535 tons in 1884, while in 1887 it was only 1,701,312 tons. The production of Bessemer steel ingots in 1884 was 1,229,000 tons, while in 1887 it had risen to 2,054,000 tons. The production of Bessemer steel in the eight chief iron and steel producing countries of the world amounted last year to 7,269,767 tons as compared with 6,034,115 tons in 1886. The general public was much interested in the application of Bessemer steel as a means of security in railway travelling, for it was reported on good authority that a locomotive engine designed and constructed by Mr. Stirling for the Great Northern Railway had accomplished, with a moderate train-load of passenger coaches, a mile in 50 seconds, or at the rate of 72 miles an hour, and made a continuous run at a speed of one mile a minute. The most important use of steel outside of railway bars and tires was its application to steamships of the mercantile marine. In 1878 there was 90 times as much iron as steel used in steamers, but in 1887 there was a little more than eight times the quantity of steel used as compared with iron. The next largest example of the growing use of steel was that of the construction of bridges. Steel had not yet met all the requirements of manufacturing engineers, and probably it would require a steel with a much larger proportion of silicon than it was the present habit to use for such purposes. He drew attention to some singular properties of manganiferous steel as discovered by Mr. R. A. Hatfield, of Sheffield, in the direction of strength and ductility. In conclusion, the President urged the importance of increasing our knowledge of alloys and their application for practical purposes—a subject which could not be overvalued when the large production of pig iron in this country and its many and various applications were considered.

Mr. Thomas Turner detailed the nature of some experiments he had made as to the condition of silicon in cast-iron, from which he deduced that silicon has the power of expelling sulphur. The conclusions derived from this portion of the subject may be briefly summarised as follows :—Under certain conditions compounds may be obtained from cast-iron which contain very considerable quantities of both sulphur and silicon. Such compounds, however, are unstable, tending to decompose on melting. The silicon with the greater part of the iron remains, while most of the sulphur is eliminated. Part of the sulphur passes away in the gaseous form, but much of it is found either in the condition of graphite matter rich in sulphur or sulphur balls. In the presence of a slag much of the eliminated sulphur is met with in the form of sulphide. It appears probable that with a certain percentage of silicon there is a definite amount of sulphur which cannot be exceeded under given furnace conditions. The general conclusions arrived at after an investigation of silicon and sulphur in the blast furnace were that in the blast furnace there are three chief agencies at work tending to eliminate sulphur, of which in Cleveland practice not more than one-twentieth passes into the iron (1) a high temperature tends to prevent the absorption of sulphur by iron; (2) a slag rich in lime readily combines with sulphur; (3) the amount of sulphur actually retained by the metal is influenced by the proportion of silicon, and probably also of other elements in the iron. For every proportion of silicon there is, with given furnace conditions, a corresponding maximum proportion of sulphur. In the blast furnace under normal conditions this maximum is not exceeded, and is very seldom reached. If by any means an excessive amount of sulphur be present, smelting eliminates sulphur and tends to produce a condition of equilibrium.

M. F. Gautier, of Paris, in a paper on "The Melting in Cupola Furnaces of Wrought Iron or Steel Scrap Mixed with Ferro-Silicon," remarked that the introduction of ferro-silicon, which has been watched with a good deal of interest in metallurgical circles, has provided us with a new alloy that has the power of converting a white pig into a grey one, and which is well adapted for the majority of foundry uses. The chief disadvantage appears to be that of cost. Experiments which the reader of the paper had made, demonstrated that ordinary wrought iron scrap, and especially of the smallest kind, which can be had at a very low price, yields probably as good results as castings made with ordinary steel scrap. In this case grey metal is obtained of a close grain and very sound castings, which are homogeneous and absolutely without blow-holes, and if we consider that the resistance of the metal to shock is usually double that which is obtained with ordinary good cast-iron, it appears that there is a special market for such castings, which might, at a comparatively low price, be substituted for the steel castings generally employed.

Mr. James Johnston gave an interesting account of the system of industrial partnership that has been carried into effect at the works of M. Godin, at Guise, in France, and also the plan of housing those who are employed in the foundry. The reader of the paper then proceeded to describe the moulding machinery and other appliances used at the works of Guise for the making of cast-iron ranges for cooking and other domestic purposes. The discussion of the paper was adjourned until the autumn meeting.

Major L. Cubillo, in the course of a paper on "Steel Castings for the Manufacture of Guns," described the experiments which he had pursued, with the view of ascertaining whether, owing to the high prices of steel forgings for the manufacture of guns, it would not be possible to produce trustworthy artillery from steel castings. The conclusion he arrived at was that, while the possibility of manufacturing great flawless steel castings might not be completely established, and while a casting by tempering at different temperatures might be capable of acquiring the characteristics of steel forged and tempered, yet the latter method must be used in the construction of guns.

Captain L. Cubillo, in a paper on "The Manufacture and Treatment of Steel for Field Guns," described the manufacture and treatment of steel for field guns as practised at Trubia.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held at Westminster Town Hall, on Monday evening, May 7th, Mr. A. T. Walmisley, President, in the chair, a paper was read on "Filtration by Machinery" by Edward Perrett, A.M.Inst. C.E.

The paper first compared the processes of straining and filtering, and pointed out that in the latter process the mutual attraction of particles of matter, in addition to the straining action, causes the retention of the suspended material in a liquid passing through the filtering medium. After describing the early experiments made by the author in filtering Thames water through filter bags such as are used for the filtration of sugar, the paper pointed out the danger of using animal charcoal for the filtration of drinking water. This material has the power of taking out matter in an infinitely fine state of division and even in solution, the charcoal becoming so charged with such matter that nothing short of subjecting the charcoal to a red heat is sufficient to thoroughly clean it. An animal charcoal filter with any system of washing will gradually accumulate the very fine matter, which may germinate, and at length be carried through with the filtered water. A filter with a granular medium (such as crushed retort coke), designed by the author, is effectually cleaned by an upward stream of compressed air occasionally applied; this causes an agitation of the material and the attrition loosens the dirt, which a small current of water washes away. At a waterworks in South America where these filters are used, 20,000 gallons of river water are filtered per hour, the floor space covered being 37 ft. by 7 ft. 6 in., or an average rate of nearly 100 gallons per square foot of filtering surface per hour.

The purification of water containing organic matter by contact with iron was mentioned. The original method of using Professor Bischoff's "spongy iron" on a large scale was to mix the spongy iron with gravel, and to use this mixture as a filter bed, but it was found that the top surface became hard and impervious after a short time, and Mr. Wm. Anderson introduced a machine to supersede these spongy iron filter beds. His "Revolving Purifier" causes ordinary iron borings to be mixed with the water as it passes through the machine; the water is afterwards filtered through ordinary sand beds

For the filtration of very muddy water for manufacturing purposes, sponge is used by the author. The machine consists of a cylindrical casing, in which sponge is compressed between two diaphragms; the lower

diaphragm is movable and attached to a piston rod, which passes through the top cover. To clean the sponge an up-and-down motion is given to the lower diaphragm or piston, thus alternately compressing and releasing the sponge. These filters will render Thames water at London clean enough for boiler-feeding or other manufacturing purposes, at the rate of about 100 gallons per square foot of surface per hour. The precipitate resulting from the processes known as "softening" water is now generally extracted by filtration. The material used for this purpose is the filter-cloth referred to at the commencement of the paper, as the chalk deposit may accumulate to a considerable thickness before it becomes impervious. In this case the deposit is easily removed; the author finds that simple external jets of water are sufficient for the purpose.

EDINBURGH ARCHITECTURAL ASSOCIATION.

On May 3rd, Mr. Gilbert Goudie read a paper on "The Brochs or Round Towers of Celtic Scotland." Proceeding to describe these unique and remarkable structures of remote antiquity, which had not previously engaged the attention of any architectural body, and are not to be confounded with the ecclesiastical round towers of Ireland or of Scotland, Mr. Goudie submitted, as a typical example, the broch in the island of Mousa, Shetland. This, the best preserved of existing specimens, is still standing to a height of upwards of forty feet. It is a circular tower consisting at first of a solid wall (unless where pierced by three chambers formed in its thickness). At the height of 8 feet this massive wall, hitherto 15 feet thick, assumes the form of two concentric walls, with an intervening space of about 3 feet, which is converted into a succession of horizontal galleries six in number—some of them about 5 feet high, and some lower, immediately above each other—and intersected by a staircase leading to the top. The central area is an open circular court of about 30 feet diameter. The only external aperture is the entrance—about 5 feet by 3 feet—passing through the main wall to the inner court, from which the stair to the galleries ascends. The stair and galleries are lighted by four sets of small rectangular window openings above each other looking into the court. The walls are of very solid masonry, the stones of good size without tool marks, and are dry built, without lime or clay mortar. There is also some rude buildings attached to the main wall on the inside, irregular in form and undeterminable in object. These architectural features described apply to broch structures everywhere, with variations in size and in constructional details in individual instances, foundations of large rambling buildings on the outside being very common. The most laborious investigators of brochs have been Dr. Joseph Anderson, the Rev. Dr. Joass, of Golspie, Sir Henry Dryden, and the late Mr. George Petrie, who have given measurements and collected a mass of information regarding their structure and contents which now enables us to treat the subject with some degree of scientific accuracy. As regards the contents of the brochs, the lapse of time since their erection and occupation has led to the destruction of what was most perishable within them, but there have been found numerous querns or hand-mills, spindle whorls of stone, stone cups, lamps, whetstones, occasional articles of bronze, such as pins and tweezers, bone combs and pins, implements of deerhorn, etc., all indications of an iron age occupancy. On one occasion in Orkney a slab bearing an incised cross with an Ogham inscription was discovered. Coming to the consideration of the origin of the brochs, the architectural features of their construction were described as being essentially native and Celtic, and so dissimilar to anything known in Scandinavia as to put out of court the contention of the late Dr. Fergusson, author of the "History of Architecture," that they were erected by the Scandinavians. The lecturer, therefore, had no hesitation in asserting the theory which assigned them to native builders, old Celts of Scotland and the isles, in the pre-Scandinavian period terminating more than a thousand years ago. They are now found in Orkney, Shetland, Caithness, Sutherland, and Rossshire, on the mainland and in the isles, but individual instances remain so far south as in Perthshire, Stirlingshire, and in Berwickshire, indicating that they existed over the whole Celtic area in this country, though lapse of time and agricultural improvements have accomplished their almost total obliteration, except in the remoter districts. It is thus in Scotland, and in Scotland alone, that these structures are to be found. The brochs appear to have been simply towers of defence, possessed of large capacity for accommodation, though by no means of a comfortable kind, and of almost unassailable strengths in the then methods of warfare. The question of the date of their erection is beset with difficulty. No record of their erection or ordinary occupation is preserved.

It has been advanced that the absence of reference to brochs by Roman authors in treating of the Conquest and partial occupancy of Caledonia, while such structures are known to have existed at one time in districts with which they were familiar—*e.g.*, the valley of the Forth, where at least one example remains—is ground for assigning their erection to an exclusively post-Roman period—*i.e.*, subsequent, say, to the fifth century. It is also the fact that articles discovered in or associated with brochs are usually of an iron age type, not indicative of the highest antiquity. But, in the opinion of the lecturer, great weight was not to be attached to negative evidence of this kind. Their existence might have been ignored by the Roman writers that are known, and, with further systematic exploration, evidence of earlier civilisation may at any time be produced, the articles at present known being naturally relics of later occupants. Some of the brochs were completely in ruin, and had become grass-grown mounds, when Pagan interments, sometimes with cremation, were made in them. Their destruction must, in any view, have taken a prodigious time to accomplish, and he was not disposed to confine their erection and occupancy within any limitation of time that it was within the power of existing knowledge to determine.

THE COUNTING OF DUST-PARTICLES IN AIR.

THE extreme importance of knowing about the nature and number of the dust-particles in the air has now been brought most prominently before physiologists and physicists. Considerable attention has been recently directed to the computation of the micro-organisms in suspension in different layers of air at different places; and the result of the work has already been very successful. But till the other day no one has ever

attempted to compute the number of "the gay motes that people the sunbeam."

The extremely fine inorganic dust which floats in the air is, in ordinary circumstances, invisible to the naked eye. But even after a room has been thoroughly cleaned, with all a housekeeper's anxiety and care, you have only to close the shutters on a sunny day, and let the sun's rays enter by a narrow chink, in order to observe the enormous number of particles glistening in the beam. So small and numerous are these motes that it seems impossible to count them with any approximation to accuracy.

About a year ago it was proved that without dust there could be no fogs, no mist, no rain. Without dust there would be only dew on the grass and road. A very simple experiment will illustrate this. Let common air be forced through a filter of cotton-wool into a glass receiver, from which the air has been exhausted. Also let a glass receiver, filled with common air, be placed beside it. If both receivers be connected with a boiler, and steam be allowed to pass into them, the following unexpected result will be seen. In the vessel containing the ordinary dusty air, the steam, as soon as it enters, will rise in a dense cloud, and this will afterwards form a beautiful white cloud, so thick that it cannot be seen through. But in the vessel containing the filtered air—that is, in which the dust has been removed by the cotton-wool—the steam is not seen at all; there is not the slightest appearance of cloudiness, although it is as full of water-vapour as the other receiver.

From this experiment it is concluded that particles of water-vapour do not combine with each other to form a cloud particle, and that some *solid* body is necessary for its formation. The fine particles of dust in the air act as free-surfaces on which the water-vapour condenses into fog. When there is an abundance of dust in the air, and only a little water-vapour, the condensed vapour forms a fog; but when the number of particles is comparatively small, each particle can take hold of a greater share of the moisture, and instead of small fog-particles being formed, mist-particles, and even rain-particles would be produced.

On the principle that every fog-particle has embosomed in it an invisible dust-particle, a method has been devised by Mr. John Aitken for counting the number of particles of dust in a given quantity of air. His plan is to dilute a definite small portion of common air with a fixed large quantity of filtered air, and allow the mixture to be super-saturated by water-vapour; the few particles of dust seize the moisture, become visible in fine drops, fall on a divided plate, and are there counted by means of a magnifying glass.

Having made these preliminary remarks on the principle involved in the experiment, we will now give a general description of the apparatus. In a common glass flask, of carafe-shape, and flat-bottomed, of 500 c. c. capacity (about 32 cubic inches) is poured 50 c. c. (about 3 c. in.) of distilled water. The dimensions are exclusive of the space occupied by the air-tight stoppper. Through this stopper are passed two small tubes, at the end of one of which is attached (a little to the side of the orifice) a small square silver table of 1 square centimetre in area (·16 sq. in.). The flask is inverted and the small silver table is placed exactly 1 c. (·39 in.) from the inverted bottom, so that the contents of air right above the table is 1 c. c. (·064 c. in.). The observing table is divided by a very fine instrument into 100 equal squares (1 mm. a side). This silver plate is very highly polished, but the burnishing is done all in one direction, so that during the observations it may appear dark when the fine rain-particles glisten with the reflected light, in order that they may be easily counted. The tube to which the silver mirror is attached, is connected with two stopcocks, one of which can admit pure filtered air from one vessel, and the other can admit small measured portions (1 c. c.) of the air to be examined. The other tube in the flask, whose extremity does not reach so high as the first, is connected with an air-pump of 150 c. c. capacity (about 10 c. ins.). Over the flask is placed a covering, coloured black in the inside. In the top of this cover is inserted a powerful magnifying glass, through which the particles on the silver table can be easily counted. A little to the side of this magnifier, is an orifice in the cover, through which light is concentrated on the silver mirror. This light, again, has had to pass through a spherical globe of water, in order to abstract the heat rays, which might injure the experiment.

This is a general description of the instrument. The experiment is performed in this way:—The air in the flask is exhausted by the air-pump. The flask is then filled with air which has been thoroughly filtered (freed from dust-particles). Into the flask is introduced a cubic centimetre of the common air which is to be examined for its dust. With one stroke of the air-pump what takes place? The air—mixture of 450 c. c. of filtered air, and 1 c. c. of common air—is made to occupy an additional space of 150 c. c. (the barrel of the air-pump); and the diminished pressure allows the water-vapour to rise from the surface of the water in the flask, or from the walls which were moistened by the inversion of the flask. The observer looking through the magnifying glass upon the mirror, sees the mist particles (formed by the moisture attaching to the dust free-surface) fall on the mirror. As these particles last for a time, he can count the number on a single square in two or three places, and take the average on the squares. Suppose the average number upon one of the squares on the mirror were one, then on the plate there would be 100; and the 100 particles of dust are those in the cubic centimetre of mixed air. But as there are 600 c. c. of air, with which the 1 c. c. of the air to be examined has been mixed, the number of dust-particles in 1 c. c. of that air is 600 by 100, equal to 60,000. By this method the number can be counted in any specimen of air.

From numerous experiments made by Mr. Aitken, he is able to give the dust-particles in a thousandth part of a cubic inch of the air examined. In outside air the number was 521, when the examination was made after a heavy rainfall, and 2,119 when the air had been for some time dry. This shows a very marked difference of four to one, and this may yet be made available as a test of the state of the atmosphere, as a help to meteorological inquiry. In his laboratory, when two lamps were burning, the number of dust-particles was 30,318 in the thousandth part of a cubic inch, and when the air was taken from near the ceiling, no less than 88,346 were counted. But when the air rising from the flame of a Bunsen burner was examined, he counted no less than 489,000 in the thousandth of a cubic inch. He is, moreover, of opinion that these figures are under rather than over stated.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

WILL MAN EVER FLY?—LANTERN-FLY.

I have been much interested in the discussions in your paper anent the question, "Will Man Ever Fly?" and without expressing an opinion one way or the other, would like to draw your attention to the manner of flight of a bird in this colony called locally "Boonea." It is about the size of a pigeon, and is coloured black and yellow; in fact, it is known as the black and yellow boonea, in contradistinction to a rather rare bird called the green and grey boonea. I have no doubt but that Mr. J. J. Quelch, the Curator of the British Guiana Museum, would describe the bird to you and be able to forward you a skeleton, as probably its formation has something to do with its manner of flight, which strikes one at once as being artificial or mechanical, and suggests almost unconsciously that that is just the way man would fly. The bird never soars or turns or sails, but just goes straight from one point to another, be that a mile or a quarter of a mile, with a regular and steady beat of the wings. The bird must not be confounded with birds of imperfect or restricted flight, such as the coot and Savanna chick and bush-fowl (the latter called here Katakka), which only fly a short distance and then drop. The boonea is a fruit-eater, and when feeding is particularly active and strong, but when flying in his artificial sort of way is sluggish, and appears to be calculating the chances of his flying machinery holding good to the end of his intended journey. I am no naturalist, but have well observed for many years the ways and habits of birds and animals in their free state, and feel sure that examination and study of the flight of the boonea will give a leg-up to the advocates of the theory of man being able to fly one of these odd days.

In your number of 23rd of March, 1888, page 279, I am sorry to see doubt cast on Madame Merian's account of the lantern-fly. Very often I have one of these beetles in my possession for several days and nights, and can speak positively of their luminosity. From the two constant lights on the top of the head it is quite easy to read ordinary print by passing the lights along the page. When they fly they give a light from under the body also, just as the light is given by the common firefly.

The light of the lantern-fly (or La Belle, as they are called in some of the West India Islands, where they are more plentiful than in British Guiana) is of different colours in different insects: in some it is green, in others red, and in others blue. Readers of the *Scientific American* for the past ten years or more will no doubt remember the numerous rediscoveries that have proved Madame Merian right, and I think she will be found to be right to the end of the chapter.

British Guiana. T.

SIR H. ROSCOE'S REPORT ON THE TREATMENT OF LONDON SEWAGE.

This report, of which you give an abstract on p. 457 of the SCIENTIFIC NEWS, is in some respects disappointing. It might have been hoped that a chemist of the indisputable merit of Sir H. Roscoe would have thrown some new and valuable light upon the sewage question, and perhaps indicated some novel and feasible process. Such, however, is not the case. Had he made himself fully acquainted with what has been already done, he would have found that materials can be added to sewage which remove, practically speaking, the whole of the suspended solids and a large part of the dissolved impurities in a harmless form. The volume of the sewage does not come into account. If a certain quantity of material will treat ten million gallons of sewage, less than 20 times as much will suffice for 200 millions. There are several such processes in existence, all essentially turning upon the use firstly of an absorbent, such as clay, peat, carbon of various kinds, coke, etc., followed up by a metallic salt. The first portion of these processes is, in fact, "inverse irrigation." In ordinary irrigation the sewage is purified by being passed through the land; here, on the contrary, the land is passed through the sewage with the same effect.

Sir H. Roscoe is undoubtedly right in his condemnation of the operations carried on by the Metropolitan Board of Works, who attempted to deodorize the river or the sewage before the elimination of the putrescible matters. Aeration is exceedingly useful as a means of putting the "finishing touch" to an effluent, but as a method of dealing with crude sewage it will, I fear, be found too expensive. J. W. SLATER.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFI NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, 323, High Holborn, London, W.C.; Newcastle Chambers, Ange Row, Nottingham; Ducie Buildings, Bank Street, Manchester and 6, Lord Street, Liverpool.*

EGG-OPENER.—An egg-opener has been patented by Mr. H. H. Lake, on behalf of W. R. Hartigan, United States. A pair of curved jaws hinged together by a spring joint are provided with spikes which perforate the egg shell on pressing the handles together.

GUNS.—Mr. H. Crampton has patented a safety appliance for guns worked with miniature ammunition. The invention is designed to prevent the fire from doing damage when they are trained into directions beyond certain limits. Over the muzzle of the gun is mounted a shutter which is usually held up by a trigger catch leaving the muzzle free. The trigger is connected by cords of determined length to fixed points one on each side of the gun. So long as the gun is trained into directions such that neither of these cords is strained the muzzle remains open and the firing is not interfered with, but if the gun is trained so that it strains either of the cords, the trigger is withdrawn and the shutter closes down over the mouth of the gun. If the firing takes place the miniature projectile is arrested by the shutter and cannot do any damage beyond.

FRESH AIR FOR UNDERGROUND RAILWAY CARRIAGES.—An apparatus for supplying fresh air to the carriages of underground railways has been patented by Mr. A. A. Clarke, of 348, Hackney Road, London. According to this invention each carriage is provided either at the end or underneath with a chamber charged with compressed air, carried up from this chamber and running along the top of the carriage is a pipe provided in the centre with a gauge for registering the pressure of the air; this pipe is also provided with one or more short tubes which are connected with a radiator for supplying air into the carriage. An advantage claimed is that the same make of cylinder as is at present used for holding compressed gas on the underground system can be employed, and also the machinery for compressing the gas into the cylinder can be made use of for compressing the air.

AERIAL MACHINE.—An aerial machine has been patented by Mr. H. J. Haddan on behalf of Mr. A. de Bausset, of Chicago, U.S.A. The elevating force necessary to float the apparatus is produced by an aërostat from which about three-fourths of the air has been exhausted. The aërostat is built up preferably of steel plates with internal cross stays, is divided into air-tight compartments, and provided with conical ends pressed outwards by springs, and with sustaining or steadying planes. The car, which is adapted for air, water, and land transit, is suspended by jointed rods,

and is provided with a roller and rope for inclining the aërostat. The vessel is propelled and steered by wheels working in a casing having valves connected by a lever. Electric motors driven by accumulators are arranged on the shaft of each wheel. A tube is passed through the cylinder, and air is admitted between it and the cylinder to assist in resisting the atmospheric pressure. The vessel is lowered by charging the cylinder with air.

STEEL PENS.—Mr. L. M. H. M. Dahms has patented an apparatus for renovating steel pens. The apparatus consists of two pieces, one of which has an angle-shaped cross section, while the other has a U-shaped one. One side of each piece has a projection to carry a pin, by which the two pieces are hinged together and around which they can rotate. The inner faces of both the angle-shaped and U-shaped are roughened. Near one end of the U-shaped piece, and between its two parallel sides, are attached the ends of two flat springs, the latter pressing from inside with their free ends against the two parallel sides of the U-shaped piece provided with file cuts. For pens that are not worn much it is sufficient to let the points slide but a few times on the inner edge of the angle-shaped piece, pressing it at the same time against the file cuts. The nib is thus sharpened, and is again fit for use. If, however, the pen has been used very much it is passed several times between one side of the U-shaped arm and the corresponding spring, and then passed between the other side and the other spring. The pen is then turned upside down and the operation repeated. During the whole time the point of the pen should touch the inner corner of the U-shaped piece.

INDUCTION APPARATUS.—Mr. J. Swinburne has patented an induction apparatus. The invention relates to induction apparatus for studying dynamo electrical machines. When it is wanted to design a new type of dynamo it is impossible to determine by calculation alone what a machine made to a given design will do, and whether the iron and copper and disposition of the machine are as good as desired. According to this invention a sort of model is made to scale. This consists of field magnets made to scale, wound with a known number of turns of wire, and of a scale model of the iron of the armature. The armature is also wound with wire, but it is unnecessary to have an ordinary commutator, as two terminals are arranged to lead the circuit in and out of the armature. The armature need not be rotated, but is held in position in the field, so that it can be moved round into an angular position representing any desired lead of the brushes. The induction through the armature corresponding to any magnetising force due to any current round the field is measured by a suitable induction balance. The induction through any section of the armature is taken by a pilot wire wound round that part. Similarly the induction through any part of the magnetic circuit can be measured. By passing a current through the armature the conditions corresponding to the dynamo's giving current can be investigated and the cross magnetisation and lead of brushes determined. A pilot coil is put round the armature at a point corresponding to the position of the brushes in the dynamo, and the induction is then found for that section and for one or two neighbouring sections, so that the lead of the brushes can be determined. By this method the whole of the data required can be determined, and the shape and disposition of the iron can be altered by a few strokes of the file.

TECHNICAL EDUCATION NOTES.

ZURICH POLYTECHNIC SCHOOL.—This school has long had the reputation of being one of the best Continental establishments for the education of engineers, architects, and chemists. A few years ago a new and very large chemical laboratory was added, and now there is in course of erection a still larger physical laboratory. Formerly the curriculum of the mechanical engineers' school contained only a very moderate amount of instruction in physics, and the head of the mechanical school was invariably an engineer. Now, however, this policy has been entirely changed. The head of the mechanical school is Professor Weber, a distinguished scientist in physics, but not a mechanical engineer, and under his auspices lessons in physical science occupy a very much larger share of the instruction supplied to those who wish to become mechanical engineers. The new laboratory will, when completed, have cost about 3,200,000fr., and will contain thirty-eight rooms where physical investigations will be carried on. Among these there will be four underground rooms, situated so low that the temperature in them will only vary by ·2°C. between summer and winter. These are intended for experiments which must be carried out at a constant temperature. In the basement of the laboratory will be installed various engines and dynamos, so that students will be able to carry out experiments on a large scale. No student will be allowed to compete for the diploma of mechanical engineer unless he has worked for at least forty days in the physical laboratory. Practical engineers here consider that this new departure in the training of mechanical engineers will not prove beneficial. They admit that a somewhat larger share of instruction in physics is desirable; but they consider that under the new programme the interests of practical engineering are likely to be injured by an overdose of theoretical physics.—*Industries*.

EXHIBITION OF WORKS IN WOOD.—At the opening on May 12th of this exhibition, Mr. S. W. Preston, the clerk of the Carpenters' Company, read an address to the Lord Mayor, tracing the circumstances which had led to the exhibition, which had arisen out of the success of the similar exhibition held in 1884. Technical education, the address proceeded, was the important question of the day, and the City and Guilds of London had now for some years been the means of bringing that education within the reach of all, and were gradually making it a necessity that every artisan worthy of the name should avail himself of it. In 1885, 1886, and 1887 the Carpenters' Company had free courses of lectures given in their hall on subjects connected with building. Last October they opened a free technical library with all the best works on carpentery and joinery, and in June next they proposed to hold an examination. This examination would be oral, and it was believed that those obtaining a certificate would find it of great advantage in obtaining situations as clerks of works. The Lord Mayor, in reply, congratulated the Carpenters' and the Joiners' Companies on the success they had achieved in their efforts to encourage the important branches of trade with which their names were identified. The examination which was to be held might have great results, and he hoped that employers of labour would encourage what was being done by giving preference to those artisans who had gained certificates.

A VALUABLE ANTISEPTIC.—Experiments made with oxynaphthoic acid, which is now produced on a large scale, show that one part of this substance kill as many yeast fungi as five parts of salicylic acid. Stirred up in cold water, this substance does not injure plants, whilst it removes vegetable diseases, and destroys vermin on fruit trees, especially the phylloxera. A number of gold-fishes, cray-fish, and leeches, living in a tank containing 880 gallons of water, were not injured by the addition of $4\frac{1}{4}$ oz. of oxynaphthoic acid, so that in such proportions it may be safely used for the disinfection of streams without any danger of injuring the fish.

ANNOUNCEMENTS.

BRITISH MUSEUM.—Four lectures, on the Social Condition of the Babylonians, will be delivered by Mr. G. Bertin, on the Fridays, June 8, 15, 22, 29, at 3.30 p.m. Tickets for the series, 15s.; for one lecture, 5s., may be had from E. A. Clarke, stationer, 38, Museum-street, W.C., and Mr. W. T. Ready, 55, Rathbone-place.

GEOLOGICAL ASSOCIATION.—The following, subject to modification, is a list of the excursions, etc., proposed for the coming season:—June 9th, Upminster; June 16th, Reading; June 23rd, Godstone and Bletchingly June 30th, Rickmansworth; July 7th, Lewisham; July 21st, Bedford; August 6th to 11th, long excursion to South Wales and Monmouthshire.

CITY AND GUILD OF LONDON INSTITUTE, FINSBURY COLLEGE.—The annual students' conversasione will be held this evening, commencing at 7 p.m. A lecture will be delivered by Professor S. P. Thompson, on "Polarisation of Light," and one by Professor T. Perry, on "Magnifying Springs." There will also be a concert, an exhibition of drawings, and apparatus.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—A general meeting of Governors and members will be held at the Society's House on Tuesday, the 22nd of May instant, at twelve o'clock noon, when the half-yearly report of the Council will be read, and the election of the President, Trustees, and Vice-Presidents, and of twenty-five members of Council, will take place.

INTERNATIONAL GARDENERS' EXHIBITION.—An International Gardeners' Exhibition, to be held in Cologne in August next, will be of some industrial importance, inasmuch as green house and garden house structures, heating apparatus, tools, and other appliances used in gardening, will form the principal feature. To insure success to this undertaking the Government has instructed its representatives in Vienna, St. Petersburg, London, Rome, Constantinople, Brussels, The Hague, Copenhagen, Stockholm, Berne, Athens, and Washington, to invite manufacturers and others to exhibit at Cologne, and to afford all requisite facilities. The Minister of Agriculture has informed the General Committee that he is prepared to offer ten first class and ten second silver medals, and twelve third class bronze medals, to stimulate competition.—*Industries.*

THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.—A conversazione of this Society was held at the Society's house, Bloomsbury-square, on Tuesday night, to celebrate the opening of the new examination hall and research laboratories. For some time past it had been felt that the accommodation afforded by the old building was insufficient for the Society's examinations, and the new rooms were undertaken to supply the deficiency. The new building occupies a site behind the two houses adjacent to the old building, and has a frontage in Pied Bull-yard. It comprises, on the ground floor, besides the entrance hall, a large examination hall, a dispensing room, and chemical examiner's laboratory; and two rooms each on the *entresol*, first and second floors. The rooms on the first floor are used as research laboratories; and those on the other floors are variously allotted. The basement contains large preparation and store rooms, as well as a boiler room, lavatories, etc. The large examination hall is about 27ft. by 48ft. with a height of 21ft. It is lighted by ceiling-lights in the centre and at the west end, and by four large windows at the east end. The research rooms on the first floor are about 27ft. by 17ft. each, are exceptionally well lighted, and have been fitted up with great care for their special requirements. The sanitary arrangements have received special attention, and the whole of the rooms have been fitted with inlet and outlet ventilators.

UNIVERSITY COLLEGE.—On May 17th Professor Erichsen, President of the University College, took the chair at the annual distribution of prizes of the Faculty of Medicine, held in the theatre of University College, when Dr. John Marshall, President of the Medical Council, performed the ceremony. The Dean of Faculty, Professor Marcus Beck, read the annual report, which showed that 322 students, of whom 78 were new students, had attended the classes of the Faculty, and the hospital classes, these numbers showing a diminution of 15 on the total, and 26 in the new students. The examinations at the London University for degrees in medicine had been attended by a large number of the students of the college; out of 23 who gained the M.D. degree, 11 were from University College. Out of 85 candidates who passed the M.B. and B.Sc. examinations 21 were sent up; and out of 186—the total number of passes in the various medical examinations at the University of London—46, or one-fourth of the whole, were gained by students from University College. In the honours list, gold medals were gained by Dr. P. D. Turner, in the M.D., and by Mr. P. Fleming, Mr. E. H. Thane, and Mr. C. W. Jecks in the M.B. examinations. Mr. W. T. Cocking obtained the number of marks qualifying for the gold medal in the M.D. Among the resignations of the year mentioned in the report was that of Professor Oliver, who had held the chair of botany with the greatest benefit to the college for 38 years. The concluding paragraphs of the report recognised the uniformly admirable conduct of the students during the year, and expressed satisfaction at the election of a member of the Faculty, Professor Erichsen, as President of the college. Mr. Michael G. Foster, of Huntingdon, was the winner of the gold medal for surgery. Mr. H. M. Fernando, of Ceylon, gained the Atchison Scholarship of £60 (tenable for two years), the gold medal for medicine, the Tuke medal in pathology, and other prizes; Mr. G. W. Sutherland, of Sydney, winner of the Bruce medal, the silver medal (equal Mr. E. Wills, of Torquay), and of several lower prizes; Mr. E. W. Selby (Lewisham) won the £100, Mr. A. G. Levy (London) the £60, and Mr. W. L. Andriezen (Ceylon) the £40 exhibitions of the entrance series. Mr. W. M. Stevens (St. Ives) won the gold medal in the senior class of physiology, and the gold medal in the senior class of anatomy. The gold medal in practical chemistry was won by Mr. B. L. Abrahams (London), the Fellowes gold medal in clinical medicine by Mr. G. R. Murray (Newcastle), the Liston gold medal in clinical surgery by Mr. W. B. Ransom (Nottingham), the Erichsen prize for practical surgery by Mr. G. B. M. White (Ampfield), and the prize for dental surgery by Mr. E. O. Turner (Lewisham).

DIARY FOR NEXT WEEK.

Monday, May 28.—Society of Chemical Industry.—*The Present Position and Prospects of the Coal Gas Industry;* by Mr. L. T. Wright.
Victoria Institute.—*The Botany of Syria;* by Prof. G. E. Post.
Aristotelian Society.—*The Demarcations and Definitions of the Subject Sciences;* by Prof. Bain.

Tuesday, May 29.—Royal Institution, at 3 p.m.—*Conventions and Conventionality in Art;* by Mr. S. Colvin.
Society of Arts.—Applied Art Section, at 8 p.m.
Institution of Civil Engineers, at 8 p.m.—*Annual General Meeting.*

Wednesday, May 30.—College of State Medicine.—*The Organisms occurring in Fresh Water, and the* by *hygienic importance of their presence;* Inspector-General J. M. Macdonald, M.D.
Society of Arts, at 8 p.m.

Thursday, May 31.—Royal Institution, at 3 p.m.—*The Growth and Sculpture of the Alps;* by Prof. T. G. Bonney.
Edinburgh Architectural Association.—*Annual Meeting.*
Society of Telegraph Engineers and Electricians, at 8 p.m.—*On the Influence Machine, from* 1788 *to* 1888; by Prof. Silvanus P. Thompson.

Friday, June 1.—Royal Institution, at 8 p.m.—*Earthquakes, and how to measure them;* by Prof. J. A. Ewing.

Saturday, June 2.—Royal Institution, at 3 p.m.—*Count Tolstoi as Novelist and Thinker;* by Prof. C. E. Turner.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch London.—All letters, Britannia Tool Factory, Colchester, England. Makers to the British Government.

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EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

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A History of Photography. Written as a Practical Guide and an Introduction to its latest Developments. With an Appendix by Dr. Maddox on the Discovery of the Gelatine-Bromide Process. By W. J. Harrison. London: Trübner and Co. Price 3s. 6d.

Manual of Artistic Anatomy. For the use of Students in Art. By John C. L. Sparkes, Principal of the Government National Art Training School, South Kensington Museum. Illustrated. London: Bailliere, Tindall, and Cox. Price 7s. 6d.

Henslow's Botany for Beginners. A Short Course of Elementary Instruction in Practical Botany, for Junior Classes and Children. By the Rev. Professor G. Henslow, M.A., F.L.S., F.G.S., author of "Floral Dissections," Lecturer on Botany at St. Bartholomew's Hospital Medical School, Examiner in Natural Science for the College of Preceptors, etc. 20 plates. Fourth edition. London: E. Stanford. Price 2s. 6d.

Electricity and Magnetism. By the late Thomas Dunman, revised and completed by Chapman Jones, F.I.C., F.C.S. With explanatory engravings. London: Ward, Lock, and Co. Price 1s.

Select Biological Memoirs. Memoirs on the Physiology of Nerve, of Muscle, and of the Electrical Organ. Translated under the superintendence of and edited by J. Burdon-Sanderson, M.D., F.R.S. London: Clarendon Press Warehouse. Price 21s.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, May 14th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	40·3 degs., being 2·6 degs. below average.	5·5 ins., being 0·7 ins. above average.	290 hrs., being 32 hrs. below average.
England, N.E.	41·4 ,, ,, 3·0 ,, ,,	5·4 ,, ,, 1·0 ,, ,,	269 ,, ,, 27 ,, ,,
England, East	42·0 ,, ,, 4·1 ,, ,,	4·5 ,, ,, 0·7 ,, ,,	265 ,, ,, 102 ,, ,,
Midlands ...	42·4 ,, ,, 3·4 ,, ,,	4·7 ,, ,, 0·5 ,, ,,	242 ,, ,, 86 ,, ,,
England, South	42·9 ,, ,, 4·2 ,, ,,	5·1 ,, ,, 0·9 ,, ,,	251 ,, ,, 96 ,, ,,
Scotland, West	40·9 ,, ,, 3·0 ,, ,,	7·7 ,, ,, 1·2 ,, ,,	318 ,, ,, 11 ,, ,,
England, N.W.	41·1 ,, ,, 4·2 ,, ,,	4·8 ,, ,, 0·0 ,, ,,	266 ,, ,, 50 ,, ,,
England, S.W.	43·2 ,, ,, 4·1 ,, ,,	6·6 ,, ,, 0·3 ,, ,,	320 ,, ,, 63 ,, ,,
Ireland, North	42·5 ,, ,, 3·5 ,, ,,	6·2 ,, ,, 0·8 ,, ,,	257 ,, ,, 77 ,, ,,
Ireland, South	44·2 ,, ,, 3·0 ,, ,,	7·1 ,, ,, 0·8 ,, ,,	313 ,, ,, 59 ,, ,,
The Kingdom...	42·1 ,, ,, 3·5 ,, ,,	5·8 ,, ,, 0·7 ,, ,,	279 ,, ,, 60 ,, ,,

The highest temperature reading during the last week of the period was 73 degs. at Strathfield Turgiss, England, South.

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 22. (*New Series.*) FRIDAY, JUNE 1st, 1888. [Weekly, Price 3d. By Post, 3½d.

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SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

IN the review of Professor Valentine's "Popular Astronomy," page 472 of this magazine, reference is made to the perturbations of Mercury, which suggested the theory of an inner planet to which the name of Vulcan was rather prematurely applied; and the reviewer adds that the anomaly in the movements of the planet "may be occasioned, not by a single planet, but by a ring-like swarm of bodies, each too small to be detected by us."

That such a ring-like swarm actually does exist is, I think, now fairly proved, and though the individual members of the swarm are not separately visible to us, the aggregation is seen as the Zodiacal light, which is a lenticular zone of nebulous matter surrounding the sun and extended in the plane of the sun's equator. We see it best after sunset at about the period of the spring equinox, and before sunrise at the corresponding autumn period, because at those times the direction of its axis is more nearly perpendicular to our horizon, and also because we then see it most completely in section, *i.e.*, we are then looking at the edge of the lens rather than its face, and thus a greater thickness is presented to us. It is best seen in tropical and sub-tropical countries. It appears as a faintly luminous cone standing somewhat aslant above the horizon. Its luminosity decreases upwards. It is somewhat opaque, and this opacity increases downwards, or as Mairan, who carefully studied its appearance under favourable conditions, says, "It was only towards the apex that I could discern the small stars on which the light was projected." This opacity and its variations correspond to what should be presented by a lenticular-shaped group of small particles thus seen, *i.e.*, with its depth or thickness in the line of sight increasing downwards.

Webb, Backhouse and Pringle have examined the Zodiacal light with the spectroscope, and find that it gives a faint continuous spectrum, just such as is given by faintly luminous solid bodies. Any kind of gaseous matter in such a position would be highly rarefied, and if luminous would display a spectrum of bright lines or bands.

Cassini and Mairan observed momentary sparklings in the luminous cone, which they explain by supposing its particles to be in rapid motion, and to present alternately faces of unequal size, nearly as one sees grains of dust sparkling in the rays of the sun.

Humboldt observed luminous undulations traversing the pyramid.

We are now enabled to explain the scurce of this remarkable solar appendage. We know that great outbursts, huge upheavals of the vaporous envelope of the sun, are continually flung outwards from the sun, forming the solar prominences. Their proceedings are now under continual observation, and are carefully recorded, especially in Italy, where a society exists (*La Societa delle Spettroscopisti Italiani*) who devote their chief attention to this subject.

Mountains of flaming hydrogen, large enough to envelope a dozen of such worlds as ours, are belching upwards from the solar surface with inconceivable fury, the flame extending ten, twenty, forty, and even a hundred thousand miles high. At the base of these gigantic outbursts incandescent vapours of some of the metals are distinguishable by the spectroscope, and there can be little doubt that as these vapours are projected further from the sun they condense into metallic hail, and are thrown far beyond the limits of the hydrogen flame, as the shots projected from a gun are projected beyond the flame of the powder.

Careful observations of the actual velocity of these outbursts have been made, and it is now demonstrable that in some cases this velocity has been sufficient to project the condensed vapours far beyond the limits of the Zodiacal light, far beyond the earth's orbit, even so far as the asteroids, and possibly beyond the limits of the solar system and the reclaiming gravitation of the sun.

On September 7th, 1871, Professor Young was observing an ordinary cloud-like prominence, and was called away. On returning in less than half-an-hour "the whole thing had been literally blown to shreds by some inconceivable up-rush from beneath." Some of the shreds had reached a height of 100,000 miles, and while he

watched them they "rose with a motion almost perceptible to the eye, until in ten minutes the uppermost were more than 200,000 miles above the solar surface." It should be noted that this velocity of 10,000 miles per minute was the mean velocity of the latter half of the observed upward journey; the initial or starting velocity must have been far greater, as the visible flames consisted of gaseous matter projected through a resisting medium.

Further details would carry me beyond my limits, but something should be added concerning the nature and origin of the force which probably produces these stupendous eruptions, from which the sun is never entirely free, their magnitude varying from barely visible mounds of flame to such as above described.

The spectroscope demonstrates that the pervading material of the mighty flash is flaming hydrogen, and we know such flame is commonly due to the combination of hydrogen with oxygen to form water. But the spectroscope is equivocal concerning oxygen in the sun, and much discussion has arisen on this point. My reply to all this is very simple, viz., that if we turn our spectroscope to a terrestrial hydrogen flame, to hydrogen in the act of combining with oxygen, the spectrum does not display the oxygen there any more decidedly than in the hydrogen flames of the solar prominences. Ergo, it is the spectroscope, not the oxygen that is at fault.

Nearly twenty years have elapsed since I ventured to affirm "that in the present state of our knowledge the spectroscope does not afford any reliable information respecting the existence or non-existence of *metalloids* in the sun—they may all be there though the spectroscope should not detect one of the them" ("The Fuel of the Sun," page 141)—and stated my reasons for this conclusion I still maintain the same in spite of all the progress made since that time.

But I am already at or near the end of my second column, and therefore must ask the editor to allow me to take up this subject of the cause of the solar outbursts next week. It is not only a big one but is very interesting, and by no means limited to what is going on in the central luminary of our own astronomical family.

THE ARTESIAN WELL OF THE PLACE HEBERT, PARIS.

ARTESIAN wells are doubtless likely to play an important part in the economy of the future. Not merely are they destined to furnish supplies of water where there is otherwise a deficiency, but it is at least possible that they may become sources of heat. In many places the temperature of the water rising from great depths is sufficiently high to serve for heating purposes of various kinds.

The well in the Place Hébert, which has been in progress for a long time, has now reached, at a depth of 719 metres, the subterranean water which it is intended to bring to the surface. Geologists and engineers find here the results of a new inquiry into the constitution of strata, into the movements and the character of the deep-lying waters, as well as into the powerful methods of boring, which are ever being improved.

The borings in the Place Hébert at La Chapelle have been undertaken and conducted by M. Lippmann, of Paris. The bulk of the work is accomplished; only the final casing-in remains to be finished, and in the meantime the rising water is turned into an adjoining sewer The diameter of the well is rather more than a metre, and if we remember that other borings in France and elsewhere do not exceed one-fifth of a metre, we see how considerable is the advance now effected.

The soil of Paris, as of all places suitable for useful artesian operations, is superimposed upon several subterranean beds of water, alternating with sedimentary strata, permeable or not. The ascensive force of these different supplies depends on the altitude of their origin.

The sheet of water reached by the well in question exists between the depths of 704 and 720 metres, lying in a watery sand, and its origin is probably in Champagne. Its purity is great; it does not mark more than 8° on the hydrotimetric scale, whereas the administrative regulations permit the use of a water supply which does not exceed 15° of this scale. The great natural filter of sand upon which the well opens insures a regular purification of the water.

The temperature of water on the surface being 53° Fahr., that of the well is about 86° Fahr., in virtue of the well-known law which gives approximately an increase of 1½° Fahr. for every 100 feet of depth.

When we find in an artesian well several sheets of water, the deepest is generally the most powerful, and it is advisable to secure it by stopping off the others. Experience shows that the power of absorption of a water-sheet is at least equal to the power of its yield. If the upper sheets of a well are left in communication with the lowest sheet, this last only discharges what the others have left it. It is therefore necessary to mask by a water-tight casing all the water-beds traversed before reaching the one which it is intended to use. A well executed at the Hospice of Tours has proved that such is the case. The borings traversed three shallower beds, which were completely shut off; the fourth, struck at a depth of 170 metres, gave a flow above ground of more than 875 gallons per minute; whilst from another well, previously sunk at the same establishment, of the same diameter, at the same level, and to exactly the same depth, which had traversed the same beds of water, but which were left in communication with each other, the yield was only one-fourth the quantity. Hence the best means are studied for blocking off the waters met with in the tertiary formations and on the surface of the cretaceous strata.

The methods of boring and casing used in practice can be here but briefly touched upon. They are known as *rope-boring* or *Chinese-boring*, *hollow-tool boring*, and *black diamond-boring*, or rather perforation by means of black diamonds. These processes are chiefly methods of exploration suitable only for small diameters. If large diameters are reached, such as 20, 24, or 28 inches, the *rigid boring* system is used. The rods are made of wood or iron, and the perforation is effected by a tool which breaks up the rocks by percussion. The boring tools employed at the Place Hébert are of this kind, but with a *free fall*. The rod of the borer is counterpoised, and the percussion upon the bottom to be perforated is effected by letting fall only the lower part of the borer, which is made very heavy. In this manner the power needed for pounding with the tool at the depth of 800 to 1,000 metres is not greater than at 100 metres, and the maximum effort is needed only when it is required to bring up the tool which was working at the bottom on account of some accident.

The tools of the borer, in searching for Artesian waters, constitute quite an arsenal. Our illustration, borrowed

from *La Nature*, reproduces the principal types of the cyclopean tools used for boring, for cleansing, for drawing samples, for widening the sides, etc. By means of the samples, which are cylindrical blocks brought to the surface, it is possible to draw exact sections of the strata which the borings have traversed. The trepan, by alternating and repeated blows, fractures and crumbles the hard layers at the bottom of the hole, and these fragments are brought up by the cleansing process. If yielding sands are met with they are supported by tubes of wrought-iron, and when the bed of water is struck tubing is inserted, which serves for the ascending column of water.

The tubing is made in sections of thick sheet-iron, from 6½ to 20 feet in length, rivetted together so as to form a single rigid column from the top to the bottom of the well. It is curious to see these tubes superimposed upon each other with accuracy, whilst within the enor-

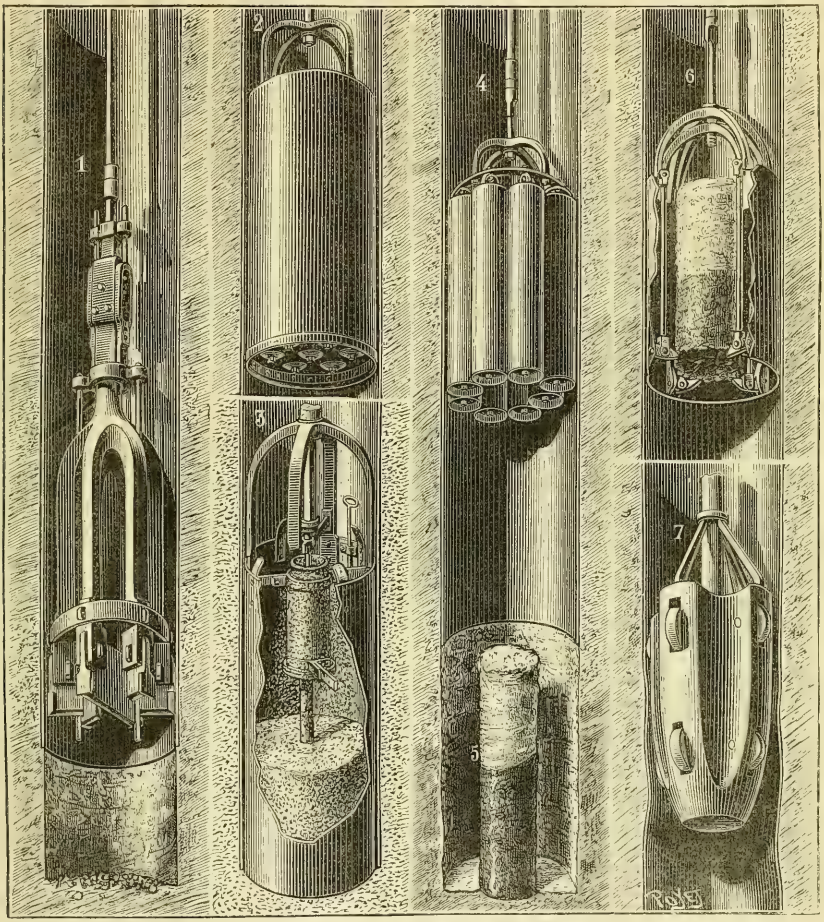

Fig. 1.—Boring Tool, 56 Inches in Diameter. Fig. 2.—Receiver, with Seven Clack Valves, for Raising the Debris. Fig. 3.—Sectional View of Receiver, with Internal Pump, Used for Raising Sand when in Great Thickness. Fig. 4.—Receiver, Formed of Eight Clack Tubes, Used for Clearing an Annular Space so as to Obtain a Sample Core. Fig. 5.—Sample Core Ready to be Raised. Fig. 6.—Sectional View of Core Being Raised. Fig. 7.—Tool, with Eight Friction Wheels for Straightening Lining Tubes 1½ Metres in Diameter, and for Breaking Up Piping which has Become Damaged.

mous trepan works and moves regularly, and almost without noise. This tool, as used in the Place Hébert, weighs about four tons, but in wells of 4 metres in diameter, like those used at Königsborn and Gelsenkirchen, it reaches nearly 27 tons. It is raised up about 16 inches from ten to fifteen times a minute, and falls back with all its weight upon the bottom, which it reduces to powder.

Sometimes accidents happen; the tubes are crushed or flattened at great depths. They have then to be extracted and raised. A length of more than 100 yards of tubing, weighing nearly 60 tons, was jammed in this manner at the Place Hébert, and it required *nine years* for its removal.

Sometimes dynamite is used to break up the parts, which are then extracted by powerful claws. But at these great depths, and under enormous pressures of water, explosives act badly. Charges of 30 lbs. of dynamite merely raise a column of water and let it fall back again. These pressures of 600 yards and upwards are so powerful that a piece of straw, carried to the bottom of the well by the borer and then brought up again in cleansing, becomes as heavy as metal, and falls to the bottom of water like lead.

THE ELECTRIC ORGAN OF THE SKATE.

FOR centuries naturalists have been interested in, and puzzled by, the electric organs of fishes, and notwithstanding the great advances of recent years, we are still unable to account for their existence. Mr. Darwin considered the electric organs as one of the special difficulties of the theory of natural selection, and so they continue to be at the present day, for, to use Mr. Darwin's words, it is impossible to conceive by what steps they have been produced.

But although it has not yet been possible to explain how these organs first originated, there is no longer any doubt as to their structure and development. Some years ago a Russian naturalist (Professor Babuchin) discovered that the electric organ of the torpedo was derived from tissues which, under ordinary circumstances, would have given rise to muscular fibres; and quite recently Professor Ewart, of Edinburgh, by studying the electric organ of the common skate (*Raia batis*) has followed every step in the process of conversion of simple muscular fibres into extremely complex electric discs.

From an abstract* of a paper recently read at the Royal Society, it appears that there is no indication of an electric organ in the young skate until it reaches a length of three or four inches. When this size is reached, some of the muscular fibres at each side of the tail of the skate lose their elongated form, and after passing through a club or mace stage, give rise to shallow cup-shaped bodies, which are soon transformed into mushroom-like structures, each with a long slender muscular stem. One stage follows another, until there is eventually produced, in great part from the original muscular fibre, a relatively large disc consisting of three important layers, viz.: (1) in front an electric plate (which corresponds to the motor plate of muscles) in which a countless number of extremely delicate nerve fibrils terminate; (2) a thick striated layer derived from the head of the club, and made up of numerous fibrils, having a sinuous or wavy arrangement; and (3) of an alveolar layer, consisting of beams running in all directions to form an irregular network with blood vessels, and gelatinous tissue filling up the meshes.

The transformation of the muscular fibre into an electric disc seems to occupy a considerable time, and, even when the disc is completed, a remnant of the original fibre may persist in the form of a delicate ribbon-shaped appendage.

But in addition to working out the development of the common skate, Professor Ewart has discovered that there is considerable variation in the structure of the electric organ in the skate genus, and especially that in several skates the electric organ is made up of beautifully moulded cup-shaped bodies which somewhat resemble the "cup" of the familiar "cup and ball." A paper giving an account of the structure of these "electric cups," was read on the 17th May at the Royal Society. The cups seem to be arranged to form two electric spindles, one at each side of the tail. Each cup consists of a thick outer layer or cortex studded with large nuclei, a median striated layer, and a thin lining—the electric plate. The cavity of each cup is occupied with nerve fibres, which as they proceed towards the electric lining divide again and again, and finally terminate in delicate loops or circles.

When Professor Ewart has communicated the further results of his investigations, it may then be possible to offer some explanation as to how muscular fibres came to be converted into electric organs, and account for the so-called "pseudo-electric" organ of the skate having a most complex structure, while it appears to have no possible function.

As long as the origin of electric organs continues a profound mystery, quite beyond the reach of the great theory of natural selection, these structures are likely to exercise not a little the minds of biologists.

* "Nature," 17th May, 1888.

THE APPLICATION OF PHOTOGRAPHY TO METEOROLOGY.

IN December, 1887, a series of large photographs, taken from the Pic du Midi, with a view to the registration of meteorological phenomena, were presented to the French Académie des Sciences by M. J. Janssen. In the beginning of October last, M. Janssen's studies on the electric absorption of oxygen induced him to spend some time at the observatory at the summit of the Pic, then under the management of M. Vaussenat, and while there, his work having brought him into contact with a clever photographer from Pau, who chanced to be then at the Pic, it occurred to him that he might avail himself of the intelligent aid of this M. Lamazouere to obtain some photographs of the atmospheric phenomena which could be so favourably observed from that elevated station. His principal aim in the work was to attract more universal attention to the important services which he felt photography might render to meteorologists and observers.

M. Lamazouere having willingly acceded to M. Janssen's proposal, they sent for a large number of 30-40 plates and other necessary materials, and commenced to take photographs of every interesting phenomenon which they witnessed during one week, the above-mentioned series being the result of their combined efforts. Four of the photographs—one of which we reproduce—of this

series form a panorama, showing the development of the whole chain of the Pyrenees as seen from the Pic du Midi, the plates having been exposed at sunrise, before the rays of the sun had touched the almost unbroken bed of clouds which filled the valleys, from which only the highest points of the chain emerged. The bed extended in this case from the ocean to the eastern spur of the group. As the sun rises, it gradually affects this cloud-bank and draws it upward, and then is seen the Janssen aptly likens to the "surges of a tempest-tossed sea;" behind it is the Arbizon, and on the horizon the groups of the Pic Poset and of the Clarabide and the Nethou.

Closely connected with these phenomena of the cloud-bank are others whose interesting meteorological causes would amply repay further investigation. Sometimes the clouds are entirely dissipated by the action of the sun; at other times they rise and form another cloud-

PHOTOGRAPH OF CLOUDS, TAKEN BY MM. JANSSEN AND LAMAZOUERE AT THE PIC DU MIDI.

phenomenon shown in another of the photographs, in which the whole chain of the Pyrenees presents the aspect of a stormy sea, the occasional summits emerging from the cloud billows bearing a striking resemblance to islands. Sometimes, as the cloud-bank rises, currents of warmer air piercing through it, carry off some of the nebulous matter, and strange flock-like forms arise from the depths of the mass. In the photographs of the chain, the Pic de la Picarde appears in the foreground, rearing its lofty head above the bank of clouds which M. mantle at a much greater altitude; or yet again they resolve themselves into a fog, which envelops the whole of the chain, completely hiding it from view. These different phenomena are due not only to the meteorological conditions of the regions where they occur, but also to the action of those foreign elements, brought by the winds, which invariably exert a strong influence on meteorology. M. Janssen has witnessed the results of this influence on several occasions, notably during his stay at the elevated station of Simla, in the Himalayas,

in 1868. During the month of December he found the atmosphere perfectly calm and the dryness extreme. Meat was never tainted and paper was especially electric to the touch. Under these conditions the solar action on the surrounding atmosphere was remarkably distinct and regular. The slight vapour emitted by the Alpine vegetations of the valleys condensed itself at sunset into a light hazy bank, which settled in the plains. At sunrise this bank rose little by little, and striking the very dry air above, instantly dispersed, the hygrometer alone disclosing its presence. As the sun sank, the vapours re-united and once more settled in the valleys, only to undergo the same transformation the next day. This regular state of things continued until January, when the winds from the Indian seas brought torrents of watery vapour, and all these phenomena were upset; in their place came storms so terrific that Europeans can scarcely form an idea of them. To analyse these changed atmospheric conditions, an exact knowledge of the importance of these new agents which thus modified the local elements would have been necessary, but it is evident that a very complete series of judiciously taken photographs would have been of inestimable value when combined with the sum total of the meteorological observations.

Some of the photographs taken from the Pic du Midi showed very interesting sunset effects; another gave a view of the east side of the chain, in which the sun was rendered positive by an excess of exposure; and another showed the snowy slopes of the Pic du Midi, upon which, on close examination, a series of little black consecutive points could be seen; the little points were in reality the photographs of the members of the French Association for the Advancement of the Sciences, who, on the 4th of October, 1887, went to visit M. Janssen at the summit of the Pic. He had been informed of their intended arrival, and had arranged the apparatus for an instantaneous photograph, which proved perfectly successful.

The station on the Pic du Midi is admirably situated for studies of this nature, and M. Janssen mentioned M. Vaussenat, the courageous and extremely devoted director, in the highest terms of praise, expressing his hope that his appointment, when it expired, would be immediately renewed. M. Janssen also expressed his regret at the rumoured abolition of several elevated meteorological stations in the United States, a step the more to be lamented, as this kind of observing station is available for special observations of great interest, particularly for those photographic studies which will, before long, lend as much assistance to meteorology, as they have already given to the sister sciences.

M. Janssen summed up the assistance rendered by photography to meteorology as follows:—

1. By giving combined images of phenomena, by aid of which these phenomena could be discussed, and which would give a new value to observations of meteorological elements.

2. By giving in particular cases, and by the employment of appropriate methods, measures of distances, altitudes, cloud dimensions, meteors, etc.

3. By unfolding a new process of photometrical measures of the light of the stars in their relation to the atmosphere. And

4. By enabling us to bequeath to futurity a mass of documents which will continue useful, even in the face of the rapid progress of science.

A NEW ANTISEPTIC SOAP.

UNTIL quite recently a satisfactory soap containing as an antiseptic one of the salts of mercury, has been difficult to prepare, on account of the alkaline soap refusing to yield a good lather, oleate of mercury being formed—a compound which has little or no germicidal action. One of the most powerful antiseptics of the mercury salts is, as is well known, the bichloride. Moreover, it is cheap, and easily soluble, but it has the disadvantages of being extremely poisonous and easily reduced by albuminoid matter, with which it combines, thus being rendered inactive. In a paper recently read before the Society of Chemical Industry in Glasgow, by Mr. John Thomson, the solubility of the red biniodide of mercury (which is claimed to be even a more powerful antiseptic than the bichloride) in iodide of potassium has been made use of. A soap can thus be easily prepared containing a certain portion of the biniodide in a soluble form. It is stated to be permanent, having no tendency to separate, and to be more germicidal in its properties than any other antiseptic soap yet known. Experiments were made to demonstrate this. Sterilised silk threads were suspended in a solution of the biniodide soap (1 gramme of soap in 120 cubic centimetres of water) for ten minutes, after being saturated with solutions containing well-known micro-organisms, amongst which were streptococcus scarlatinæ (Klein), bacillus subtilis, orange sarcina, white bacillus from Tweed water, organisms from putrid urine, the micrococcus of osteo-myelitis, aspergillus nigrescens, spores from various fungi, yellow micrococcus from pus, putrefactive organisms, bacterium termo, and bacillus scarlatinæ (Edington). The threads were then carefully washed to remove the soap, and placed in sterilised gelatine in the ordinary way. The threads were controlled by first sterilising, and then plunging into nutrient gelatine; if no growth occurred they were accepted as being fit for use in the experiment. Washing the threads previously contaminated with organisms two or three times carefully with distilled water, was shown by experiment not to remove the organisms, for on being placed in the gelatine growth readily took place. The results, as shown in tables, are very remarkable. In all the experiments, with a few very uncertain exceptions, growth of the organisms was completely prevented, even after the lapse of four days. Similar experiments made with "carbolate of mercury" soap showed it to be less powerful as a disinfectant, and much slower in its germicidal action. In experiments carried out in the same manner with other antiseptic and ordinary soaps, it was shown that the growth of the organisms in many cases was not prevented. The importance of such a soap in medical and sanitary science is very obvious. The biniodide soap has been used in the treatment of eczema with well-marked success, especially where the irritation is due to the fermentations of accumulated secretions, the fermentations being set up by micro-organisms. It has also met with similar success when used in parasitic skin diseases, such as favus and ringworm. As a parasiticide, too, the importance of its application to patients during the period of desquamation in scarlet fever is evident.—*Lancet.*

CARNIVOROUS CHARACTER OF THE SQUIRREL.—Mr. E. E. Barclay, of Cedar Lawn, Essex (*Field*) gives, from an eye-witness, an instance of a squirrel attacking and killing a full-grown thrush.

General Notes.

Sawerthal's Comet.—This comet, of which we gave an illustration on p. 393, according to Dr. Schwar, of the Dorpat Observatory, increased in brightness by two or three magnitudes between the 20th and 22nd ult.

The Spread of Cholera.—Sir Joseph Fayrer in a recent lecture mentions that in Bengal cholera advances not with the rivers, but rather against them. Hence contaminated water cannot be the sole agent for the propagation of the disease.

The Theory of Diamagnetism.—M. R. Blondlot (*Comptes Rendus*) maintains the validity of Becquerel's theory which considers that all bodies, and even void space, are paramagnetic, a diamagnetic body being simply a body less magnetic than is a vacuum.

Tea Culture in Natal.—The growth of tea in Natal has been attempted on a fairly large scale, and has proved successful. In 1886 the total area planted with tea-trees was 600 acres, with a yield of 57,000 lbs. Last year a crop of from 100,000 to 120,000 lbs. was expected.

The Diameter of the Sun.—M. Auwers has deduced for this diameter the value of 32 minutes, 2 seconds, founding his calculations on the observations taken at Greenwich, Washington, Oxford, and Neuchatel. No decrease of this diameter, and no periodical variation can be detected after a minute study for 33 years.

Leaden Water-Pipes.—M. Hamon (*Cosmos*) protests against the employment of leaden service-pipes under any circumstances, contending that all waters attack lead more or less, their action being increased by the presence of organic matter, or of nitric and nitrous acids. Even an imponderable trace of lead in water is unsafe.

Atmospheric Phenomenon.—At Moscow on May 19th a remarkable atmospheric phenomenon was observed at sunset. The rays of the sun were intercepted by a cloud, and, owing to some unusual refractive power of the atmosphere, the entire city was coloured a vivid purple hue. The curious effect lasted about eight minutes.

Parallaxes of Stars. — Mr. Pritchard finds the parallax of *u* Cassiopea to be 0·05, so that its light will be 70 years in reaching our earth. He calculates the distance of the Polar star to be approximately the same, and announces that by his photographic process he will be able to find the distances of 10 to 15 stars every year.

New Antiseptic.—Dr. Th. Schneider (*Correspondenz-Blatt für Schweitzer Aerzte* and *British Medical Journal*) recommends a mixture of 1 part crystalline carbolic acid and 3 parts of camphor, well shaken up together. The mixture is said to possess the antiseptic power of carbolic acid without its irritating and caustic properties and its peculiar odour.

Conversion of Peat into Coal.—The *Revue Scientifique* describes this conversion as being in practical operation in England, and as being in use for metallurgical purposes. The material is brought to the specific gravity of 1·25 by means of pressure and desiccation. One hundred tons of peat yield only twenty tons of coal, which, however, will be free from sulphur.

Climate of Constantinople.—The annual mean results, according to Coumbury Effendi (*Revue Francaise*) are:—Days of rain, 84; days of snow, 14; days of storm, 15; days of northerly winds, 243; days of southerly winds, 122; temperature, 57·7 deg. F. The mean annual velocity of the the wind and the average of sunshine and cloudiness—two most important factors—are not given.

Danger of Pyrogallic Acid.—This substance, so much used by photographers, is a formidable poison, and should be kept out of the way of meddlers. According to the *Photographisches Archiv*, a child which had strayed into the workroom of a photographer, in a small Rhenish town took up a glass containing a solution of this acid and drank some. It would undoubtedly have perished if the father had not had the presence of mind to administer an emetic.

Adulterant for Chocolates. — According to the *Analyst*, in the last issue of the *International Review of Food Adulteration*, published in Holland, an English firm is charged with offering for sale to manufacturers of chocolate a brown substance, designed to improve the colour. The powder is specially recommended as quite non-injurious, very light, and of great staining power. It was found to be a mixture of oxides of iron and aluminium. We (*Analyst*) should fancy that foreign makers of chocolate do not require any instructions from England as to the use of red ochre.

Taverns and Public Health.—*Cosmos* notes the tenfold increase of mental alienation since the commencement of the century, and connects this fact with the multiplication of taverns in the north of France. In Valenciennes there were in 1876 121 establishments for the sale of alcoholic liquors; in 1880 they had reached 501, and in 1887 652, in a population of 27,500. Whilst alcoholism, and especially the use of absinthe, has undeniably an injurious action upon the brain, we must not forget that other factors have been at work in the increase of insanity.

Movement among the Scientific Societies of Edinburgh.—According to the *Scotsman*, the Scientific societies of Edinburgh are entering into negotiations with a view to a kind of amalgamation with the Philosophical Institution. Each society is to retain its individuality, and carry on its special work as heretofore; but the Philosophical Institution is to form their common head-quarters, where their libraries and other belongings are to be kept. Such a step, if it can be carried out, will considerably reduce the working expenses of the societies, and prove a convenience to many of the members.

The Linnæan Society.—This Society, which in its position ranks second to the Royal Society alone, cele-

brated its centenary on May 24th, the birthday of the eminent naturalist whose name it bears. For a long time it remained the sole focus of biological science in this country, and though its scope has been narrowed by the formation of the Zoological Society in 1826, and of the Entomological Society in 1833, it still maintains an unsurpassed reputation. It will ever be held in honourable remembrance as the place where the original papers of Charles Darwin and Mr. A. R. Wallace on "Organic Evolution" were first made public.

M. Pasteur's System and the Cattle Plague.—The recent experimental inoculations against the Siberian Cattle Plague which have been carried out on a hundred Merino sheep by Dr. Gamalea, of the Bacteriological station at Odessa, have given the most hopeful results. Some time will, of course, be required to prove the absolute efficacy of the system. The importance of the success of this means of eradicating this disease in Russia will, perhaps, be more readily understood when it is stated that during last year, in the single province of Kherson alone, the loss to proprietors by the ravages of this disease amounted to more than three millions of roubles. If this method succeeds in combating the disease it will prove a great boon, as in the whole of Southern Russia, the Siberian plague and the ordinary cattle plague have hitherto had a permanent habitat, and their yearly recurrence has poverished thousands of peasant proprietors and owners of sheep runs and cattle ranches.

Fixation of Nitrogen by the Soil and by Plants.—MM. Arm. Gautier and R. Drouin (*Comptes Rendus*) conclude that the bare soil derives from the atmosphere noteworthy quantities of nitrogen if only it contains organic matter such as humus, which is the necessary medium of such derivation. Oxides of iron accelerate the process, but they are not absolutely necessary. Whatever may be its initial state the nitrogen thus taken from the atmosphere is transformed into organic nitrogen. The soil is the seat of a continual loss of the ammoniacal nitrogen, which is brought by the wind and the rain, or which is liberated by the bacterian fermentations taking place in its midst. But in arable soils the intervention of the nitric ferment checks this action by annulling the ammoniacal tension. The total quantity of nitrogen assimilated in about three months by bare soils, in presence of organic matter, is for the same surface and the same period ten times greater than the quantity of ammoniacal nitrogen fixed by acidulated water exposed to the air of the fields.

Photographs of the Eye, by the Flash of Magnesium Powder.—The effects of complete darkness upon the normal pupil have hitherto been ascertained only by the sudden light of an electric discharge, which does not admit of any measurement. HH. Miethe and Gaedicke (*Cosmos and La Nature*), by the well-known magnesium powder, have furnished science with a much simpler method. A photograph of the eye may be taken in a totally dark chamber, thus obtaining the image of the pupil when fully dilated, for there is not time for it to contract before the end of the operation. Dr. Miethe, of the Observatory of Potsdam, suggested to Professor Du Bois-Reymond the idea of taking a photograph of the normal eye in its natural size after remaining for fifteen minutes in absolute darkness. The pupil in the proof thus obtained measures 10 millimetres horizontally, the width of the corner being 13 millimetres. In the corner can be seen the reflection of the flash of the magnesium. Photographs of this kind will be very valuable to ophthalmologists.

The Direct Production of Pure Hot Air from Coal. — Under this misleading title the *Times* has favoured its readers with a very ecstatic, and at the same time very extraordinary, description of an apparatus for heating air, recently made by Mr. W. A. Gibbs, of Chingford. The writer calmly asserts that "The discovery is that perfectly pure air can be produced from the combustion of coal," and he naively adds that "this discovery is mainly due to the circumstance that the production of air under such conditions was a desideratum." The *Times* has lately advocated the spread of technical instruction, but it is self-denying indeed to publish the fact that even its own writers on technical subjects are in such dire need of elementary teaching in science. Air is a mixture of oxygen and nitrogen in well known proportions, and to talk of a carbonaceous substance such as coal being converted into oxygen or nitrogen is simply absurd. It is absolutely impossible, and if air is the agent by means of which the fuel is oxidised, the products of combustion must necessarily consist chiefly of the oxides of carbon and water vapour. The writer of the article, however, not only states that this "pure air" can be inhaled without injury or inconvenience, but that he actually faced a strong blast of it at a temperature of 500 degs. Fahrenheit, without being in any way the worse. The writer is really too modest, it is he—not Mr. Gibbs—who has made the greatest discovery, and we sincerely trust that he will meet with his deserts, not only in Printing House Square, but at Burlington House.

A French Explorer in South America.—At the last meeting of the French Geographical Society, in Paris, M. Marcel Monnier gave a very interesting account of his travels across South America from the Pacific coast to the Para. M. Monnier stated that he encountered very great difficulties in Peru, and that he was a long time in getting through the upper valley of the Rio Maranon to the eastern chain of the Andes. Owing to a revolt in this region he was compelled to branch off about 150 miles to the south, towards the province of Pataz, one of the most rocky and savage districts of the Peruvian Andes, and reached the village of Tayabamba, which is one of the most extreme inhabited points in the whole chain. From there, accompanied by only five Indians, he crossed on foot the Eastern Cordillera as far as the upper course of the Rio Huallaga, the march being a very difficult one, as for the greater part of the way he and his companions had to cut their way with axes through dense jungles, with nothing but the compass to guide them. They took three weeks to travel 90 miles, being on foot about nine hours each day. Upon reaching the banks of the Huallaga M. Monnier descended the stream for a distance of about 350 miles, as far as its junction with the Maranon, upon a small raft, or balsa, navigated by four Indians. It so happened that, after eight months' travelling under these difficult circumstances, M. Monnier was shipwrecked when in sight of the French coast on his way home, and unfortunately lost the greater part of the interesting collection. He was able, however, to save his diary and some of his sketches.

EXPERIMENTS WITH THE MAGIC LANTERN.

IN a former article we pointed out the value of the magic lantern as a teaching appliance, and advocated the use of slides to illustrate history, geography, etc., which can be easily prepared by the average amateur photographer. But the lantern is not only serviceable for the exhibition of pictures and diagrams, for it can be turned to excellent use as a means of showing actual experiments. Its power of magnification is its chief value in this service. There are hundreds of experiments which cannot, by reason of the small area to which they are confined, be effectively exhibited before a number of spectators. Should a teacher or lecturer attempt to perform one of these, he has to report the results by word of mouth to his hearers. He tells them that he has just done such and such a thing, and he now observes that such and such a result is becoming visible. But the audience want to see the result for themselves, and unless they can do so the value of the demonstration is altogether lost. Let us cite as an example of this a well-

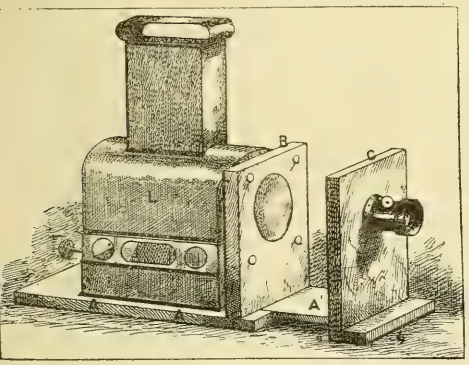

FIG. 1.

known experiment—the electrolysis of water. The usual requirements for this experiment consist of a vessel of acidulated water containing two inverted tubes, also filled with the same liquid, and each of which covers a piece of platinum foil. These slips of foil are connected with the electrodes of a battery, consisting usually of two or three Bunsen cells. Directly connection is established with the battery bubbles rise from the platinum slips, and the gases evolved from the decomposition of the water are collected in the tubes. Those who are close to the lecture table have no difficulty in watching the progress of the experiments, but to those in the background it is almost invisible. But let this experiment be transferred to the lantern, and the images of the two tubes are shown six or eight feet long, and every bubble of gas which traverses the water which they contain is visible to every one of a large audience. Of course a special form of slide is necessary, containing two tiny tubes, which can easily be connected with a battery cell outside the lantern. The experiment under these circumstances is on such a tiny scale, although it appears so large, that a single bichromate cell is quite sufficient for the purpose. It is our intention in these articles to show how apparatus for this and other experiments can be easily contrived by those who have a little mechanical ingenuity.

It is a pity that makers of lanterns generally do not provide appliances for the ready performance of experiments. In certain German models which we have seen, the space between the condensing lens and the objective is left entirely open, instead of being closed in as is the case with English lanterns. This space is occupied by a kind of table, which can be adjusted to any height, and the image of anything placed thereon is projected upon the screen. The possessor of any lantern which is furnished with a separate three or four wick lamp, can easily construct for himself, or have made by a carpenter, an addition which will at once enable him to perform all kinds of experiments. This simple contrivance is shown at fig. 1.

AA is a base-board about one foot in length, and slid-

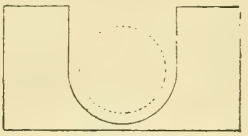

FIG. 2.

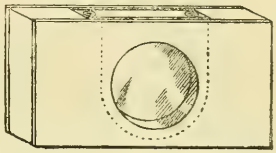

FIG. 3.

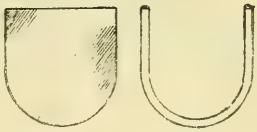

FIG. 4. FIG. 5.

ing in to it is another smaller board A^1, which carries the upright C. B is a fixed and similar upright, screwed down to AA. L is the mineral oil lamp as usually supplied to lanterns, and which can be purchased separately if desired. The two dotted lines across the upright B show the position of a circular hole which is destined to receive the condensing lens, while a similar but smaller hole in C holds the objective D. Any one already in possession of a $\frac{1}{4}$-plate photographic portrait lens can use this as the objective, with the certainty that it will give a good result. The two projections on B are milled screws, which can be adjusted to hold slides of different thicknesses, close to the condensing lens. In using this contrivance the slide is roughly focussed by moving A^1 in or out, as the case may be, while the fine adjustment is represented by the rack and pinion on the front lens. We have little doubt that any lantern maker would carry out these ideas if he were instructed to do so, but others, who are able to use carpenters' tools, will be independent of his services.

A great number of experiments possible with the

lantern may be described as tank experiments, for they require a special form of glass tank for their performance. This tank can be easily made from three pieces of wood, two pieces of glass, and a short length of indiarubber tubing. Its construction is as follows :—

A piece of pine or mahogany, measuring 7 by 4 inches, and five-eighths of an inch in thickness, is cut out with a fret saw to the form shown in fig. 2. This is the foundation of the tank. Two more pieces of wood of the same dimensions are now provided, but they should not be more than one-eighth of an inch in thickness. Each of these pieces is pierced in its centre with a 3-inch hole, and each piece is then glued and pinned to the foundation (fig. 2). The slide will then approach the appearance of fig. 3; but it is not yet provided with its glass sides. These glasses, of the flattest and whitest kind, must be cut to the shape of the opening in fig. 2 (as shown at fig. 4), and must just fit that opening without strain. When the glue is dry they can be placed in position, and then separated from one another by the piece of rubber tubing (fig. 5). This last addition completes the tank, the tubing being so pressed between the glasses that it is perfectly watertight. The contrivance is quickly and cheaply made, and has the advantage of being taken to pieces without difficulty for cleaning. As the tank is chiefly used for chemical experiments the necessity for thorough cleaning after use will be readily apparent.

CAMBRIDGE.—The following is a list of the distinguished persons upon whom it is proposed to grant honorary degrees on June 9th. The degree of LL.D. (*honoris causâ*) will be conferred on :—

1. His Royal Highness Prince Albert Victor Christian Edward of Wales.
2. The Marquis of Salisbury, K.G., D.C.L., F.R.S., Chancellor of the University of Oxford.
3. The Earl of Selborne, D.C.L., F.R.S.
4. The Earl of Rosebery, F.R.S.
5. Lord Randolph Churchill, M.P.
6. Lord Acton, D.C.L.
7. The Right Hon. G. J. Goschen, M.A., M.P., Chancellor of the Exchequer.
8. The Right Hon. John Bright, D.C.L., M.P.
9. The Right Hon. H. C. Raikes, M.A., Trinity, one of the members for the University and Postmaster-General.
10. The Right Hon. A. J. Balfour, M.A., M.P., Trinity College, Secretary of State for Ireland.
11. Lieut.-General Sir Archibald Alison, G.C.B.
12. Professor George Gabriel Stokes, M.A., M.P., of Pembroke College, President of the Royal Society. The honorary degree of Doctor in Science will also be conferred upon him.

The honorary degree of Doctor in Science will also be conferred upon :—

1. Lord Rayleigh, M.A., F.R.S., Honorary Fellow of Trinity College.
2. Sir F. A. Abel, C.B., D.C.L., F.R.S., Director of the Chemical Establishment of the War Department.
3. Professor Arthur Cayley, M.A., F.R.S., of Trinity College.
4. Professor J. C. Adams, M.A., F.R.S., of Pembroke College, and Honorary Fellow of St. John's College.

The Chancellor of the University, the Duke of Devonshire, will preside at the Congregation at which the above degrees will be conferred.

NEW OBSERVATIONS ON THE "CANALS" OF THE PLANET MARS.

M. PERROTIN, writing in the *Comptes Rendus*, states that he has lately had the opportunity of re-examining with a good refracting telescope a portion of the so-called "canals" of Mars, which he studied two years ago.

They are still in the position where the author saw them in 1886, and they present the same characters. They stand out upon the reddish ground of the continents of the planet as dark straight lines (probably arcs of a great circle), some of them single and the others double—the two component lines being in this case most commonly parallel. They intersect each other at different angles, and seem to establish communications between the seas of the two hemispheres, or between the different parts of one and the same hemisphere.

Their appearance is, in general, the same as it was in 1886. Some, however, appear fainter, whilst others have in part disappeared. But three important changes have taken place in the meantime, which are the more certain as they have their seat in those regions to which the author's attention was particularly turned in 1886.

The first of these modifications is the disappearance of a continent which extended then on both sides of the equator through 270° of longitude. It was called *Lybia* in the map drawn up by Schiaparelli. It was triangular in form, being bounded on the south and the west by a sea, and on the north and the east by canals. But this region, distinctly visible two years ago, now exists no longer. The adjacent sea, if sea it be, has totally invaded it. To the reddish-white tint of the continent there has succeeded the blackish or rather deep blue tint of the seas of Mars. A lake, situated along one of the canals, has likewise disappeared.

The extent of the region thus completely changed in its aspect is a little larger than the entire surface of France. Whilst encroaching upon this continent the sea has abandoned, to the south, the regions which it formerly covered, and which now present a tint intermediate between that of the continents and that of the seas.

This inundation, or whatever else the phenomenon may be, if we are to rely upon a drawing made in 1882, may be periodic in its character. If so, further observations will detect its law.

Further to the north of the vanished continent, in about 25° latitude, there is a single canal not marked in the chart of Schiaparelli, though this learned astronomer has laid down others which are much fainter. This canal, which extends 20° in length, and has a breadth of 1° or 1·5°, is beyond doubt of recent formation. It is parallel to the equator, and is the prolongation of a double canal, previously existing, which it connects with the sea.

The third change consists in the very unexpected presence upon the white cap of the North Pole of a canal which seems to form a straight connection, passing right through the Polar ices between two arctic seas.

It is obviously premature to speculate on the nature and the causes of these phenomena. It might be asked whether the disappearance of a continent is an instance of subsidence, or whether we have to do with cataclysms like those of Adhémar? M. Faye suggests that the canals may be furrows torn by the tides, which, owing to the proximity of the inferior satellite of Mars, may be very high and powerful.

Natural History.

THE CRICKET.

Crickets, it appears, like beings much higher in the scale of creation, have their "aspirations," which they follow up, as far as in them lies, by making themselves a formidable nuisance. Such is the present state of affairs in the fruitful and prosperous French province of Algeria, which these greedy and multitudinous insects are busily devastating. So wide-spread is the havoc that it is discussed in leading articles by the daily press of Europe.

As Algeria is from time to time visited by swarms of locusts and of grashoppers, our readers may wish to learn how these pests, so closely allied, are to be distinguished from each other.

We will, therefore, seek to point out the characteristics of these families, so far as this can be done in non-technical language.

To this end we must introduce our friends to a very far-descended race — the so-called *Orthoptera*, or straight-winged insects. These creatures, as far as our present knowledge extends, were the earliest insects to appear on our earth, their remains being at times found in strata of very remote antiquity, long prior to the first occurrence of beetles, bees, or butterflies. Their long pedigree is, for the most part, all that can be advanced in their favour. Many of them are utterly devoid of beauty; all are very greedy, and they oft-times multiply to such an extent as to become a public calamity, involving famine and sometimes pestilence.

The diet of orthopterous insects is various, including both vegetable and and animal matter. Their intelligence is very low, and they have not the power of acting in concert. Had they the understanding of ants, bees, and wasps, the very lives of man and of domestic animals would often be placed in imminent danger. But as it is, we may go on slaughtering them in detail without the whole swarm falling upon us in revenge.

A characteristic feature of all orthopterous insects is that they do not, like the higher orders, undergo any transformations, but issue from the egg substantially in the same form which they retain through life, the most important change which they experience being the growth of their wings.

By this feature especially, they are distinguished from beetles, which issue from the egg as a grub. This difference is the more important as one orthopterous species, the cockroach or kackerlack (*Periplaneta Orientalis*), which has unfortunately become naturalised in this country, is called, in the language of the kitchen, "black-beedle." Any one who takes the trouble to compare this pest with any beetle, must perceive at once the difference. We regret that this confusion should prevail, since it leads to the massacre of certain insects which are not merely harmless but useful, and which perish under the mistaken imputation of being cockroaches. This is a mistake parallel to that committed by certain farmers who actually destroyed ladybirds, supposing them to be the dreaded Colorado beetle.

The crickets belong to an orthopterous group known as *Saltatoria*, from their leaping powers. On examining a locust or cricket, we see at once that the thighs of the hind legs are exceedingly powerful, and clubbed at the upper extremity—a construction which we meet with in all animals specially formed for leaping, from the flea to the tiger. These leaping orthoptera consist of three families—the crickets, the grasshoppers, and the locusts.

Fig. 1.—Mole-Cricket (Gryllotalpa Vulgaris), with its Underground Nest.

At first glance the insects of these three families might seem undistinguishable.

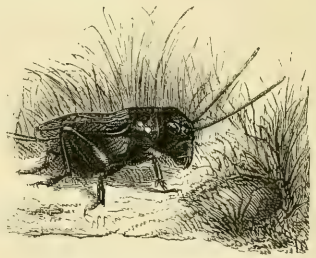

Fig. 2.—Field-Cricket.

But in the *Achetidae* or crickets, the group which we have more particularly in view, the wings are laid flat over the back; and at the end of the body, in both sexes, there are two long bristles, in addition to the ovipositor

of the female, a projecting organ by means of which she inserts her eggs in suitable crevices. In the grass-hoppers, or *Gryllidae*, and the locusts, or *Locustidae*, the wings and their covers are not laid flat over the back, but placed sloping so as to cover the sides of the abdomen; the bristles at the hinder extremity of the body are wanting, and in the locusts the female has no projecting egg-tube.

Of true crickets we have in Britain five species, one of which, *Gryllotalpa vulgaris*, the mole-cricket, so called from the structure of its fore legs, would be dangerous to our crops if more common. The mole-cricket, with its underground nest, is shown in fig. 1. The field cricket is shown in fig. 2. The well-known house cricket (*Acheta domestica*) is a fairly voracious animal, and often damages woollen garments and shoes left in warm kitchens. It is sometimes tolerated by house-keepers under the impression that it wages war against the cockroaches, a subject on which further careful observation is needed. Cases, however, have come under our notice where both these insects have flourished in the same house in apparent peace and amity.

The house-cricket figures to some extent in folk-lore. In many districts they are deemed to bring good luck, and to kill them is thought very imprudent. In others they are prophets of evil. If, especially, a single cricket is heard chirping in a house which they have not hitherto infested, it is said to foretell the death of some member of the family.

In the first reports from Algeria, there was no exact description of the species at present complained of. It was said to be swifter in its movements than the grass-hoppers and locusts which so often lay waste districts of Northern Africa, and to be hence more difficult to encounter. But it seems that the French give the name of *criquet* both to the true crickets such as we have described above and to juvenile locusts before they have acquired wings.

Such, in fact, are the swarms now ravaging Algeria. It seems that the Arab and Moorish inhabitants content themselves with destroying, as far as practicable, all these insects when they appear in force, and do not make any attempt to discover and destroy their ova. Nor is there any continuous systematic action kept up year by year and throughout the country. As in regions nearer home, the public on the appearance of any danger pass at once from carelessness to panic.

The Feet of Bees.—Professor Cook in a paper on the morphology of the legs of the *Hymenoptera* (*American Naturalist*) says that the pulvilli are situated between the claws. They are large and glandular, and by secreting a viscid material enable a bee to walk up glass. We thus understand why a bee fails in an attempt to walk up a moistened or powdered glass surface. When a bee walks on wood the pulvilli are turned back, when on glass the claws are retracted.

A Pleasant Poison for Horses.—In Northern Texas and some neighbouring parts horses seem to have discovered for themselves a seductive luxury to which they fall victims, as does man to narcotics. The plant in question is colloquially named "loco," but Mr. R. Aldridge, who gives an account of it (*Field*) does not furnish its botanical name. It has small leaves and purple flowers, and keeps green when the grass withers. A horse which becomes addicted to this vice loses flesh; his eye becomes dull and glazed, his temper morose, and he shuns the society of his kind. The most curious characteristic of a loco-eater is that in order to get over any obstacle he raises his feet three times as high as it is needful.

The Gemsbock.—According to Mr. A. H. Godfrey (*Field*), the gemsbock at a distance appears of a dull uniform grey, but it has a black list along the spine and two dark horizontal stripes on each side (? *directive colouration*). An adult male in good condition weighs about 700 lbs. The horns, which have a very slight backward curve, are from 3 feet to 3 feet 6 inches in length, marked at the base with spinal rings, but smooth along the upper part. With these they have been known to beat off and even kill a lion.

Wild Fruits of Manitoba.—According to a contemporary, in all parts of this province wild berries, small fruits, and nuts are abundant and of good flavour. The list comprises the plum, three sorts of cherries, the saskatoon or pembina (making a fine preserve), currants, gooseberries, raspberries and cranberries, grapes (along the southern river-banks) and strawberries, universally distributed.

On the Gemmules of certain Marine Silicispongiæ.—M. E. Topsent (*Comptes Rendus*) finds that similarly to the spongillæ, multiplication by means of gemmules, in addition to sexual reproduction occurs in several silicispongiæ common on the coasts of the Channel belonging to different families. These non-sexual germs are composed of elements of a comparatively large size deepened by a strong accumulation in their protoplasm of large brilliant granules which conceal the cellular nucleus, and secondly of a covering of keratoda.

Cunning of the Red Fox.—Miss M. E. Holmes (*American Naturalist*) gives some interesting facts showing the intelligence of the American species, *Vulpes rufus*. If a bit of meat remained from his dinner, he would dig a hole, drop it in, and with his sharp nose press it down closely, then cover it, and looking round for fear of being overlooked would scatter pine-needles over the place until one could scarcely detect the freshly-stirred earth.

The Urania Riphœus.—M. Paul Camboné (*Cosmos*) announces that a friend of his in Madagascar has succeeded in rearing this magnificent moth from the caterpillar, and in noting the chief particulars of its life-history. M. Camboné is about to publish a memoir on the subject.

Weeds in America.—Of eighty-eight species of weeds described by Mr. L. H. Pammel (*Popular Science Monthly*) as growing in south-western Wisconsin, and south-eastern Missouri, 46 are European immigrants and only 30 are native Americans. Nearly one-fourth of the whole belong to the order of *Compositae*.

"Directive" Colouration in Animals.—Mr. J. E. Todd, discussing this subject in the *American Naturalist*, defines directive colouration as that which is in any way useful to a species, by assisting in mutual recognition between individuals, or by indicating one to another their attitude of body, and probable movements. Of this he gives a number of instances.

Hypocrisy of a Dog. — Prof. S. V. Clevenger (*American Naturalist*) mentions that a dog which had had a severe cold and cough was allowed to stay in the house. Since his recovery if any mention is made of turning him out of doors he coughs vigorously, and wheezes in fair imitation of asthma. When turned out he at once drops the pretence and rushes off in search of company.

Evolution *v.* Special Origination.—It is now found that the doctrine of the fixity of animal and vegetable species is due mainly to John Milton and John Ray. It was rejected by Bacon and by St. Thomas Aquinas.

A Colour-yielding "Germ."—M. Galtier (*Comptes Rendus*) has observed a morbid bacillus which, if placed in contact with various kinds of organic matter, such as gelatine, beef-broth, or potato, has the power of generating a peculiar green colour, inclining in some cases to a yellow and in others to a bronze. This discovery suggests some interesting possibilities. Shall we some day employ bacilli, or other microbia, in manufacturing colours for the dyer, and perhaps producing them on the tissues themselves?

RELATIONS OF ANIMALS TO PLANTS.

BETWEEN the animal and the vegetable world there prevails for the most part a state of hostility. From man, who in his mistaken greed cuts down every tree in his neighbourhood, to the goat which browses away young saplings, the hare and rabbit which gnaw away the bark, the phylloxera which ravages vineyards, the cockchafer, the caterpillar, and the locust which consume leaves, not to speak of myriads of other species, we perceive a constant war being waged against plants. It is therefore consolatory to find some instances of an opposite kind. To what an extent bees, butterflies, and even one family of two-winged flies, the *Syrphidæ*, are instrumental in effecting the fertilisation of flowers is now very generally known. But other instances are coming to light. Thus it has lately been shown that even certain ants—those, at least, which do not cut leaves and domesticate aphides—may be of service to plants. Thus our regretted friend, Thomas Belt, mentions, in his charming "Naturalist in Nicaragua," that a kind of acacia, the bull's-horn thorn, keeps an army of venomous ants (*Pseudomyrma bicolor*), which protect it both from browsing mammalia, from caterpillars, and from leaf-cutters. These guards receive as their pay a honey-like liquid, secreted at the base of each pair of leaflets, and on a little yellow, fruit-like body at the end of each of the small divisions of the compound leaflet.

Some interesting researches of Axel Lundström (*Transactions of the Royal Society of Upsala*, abstracted in *Humboldt*) show that even certain mites are found associated with plants in a manner mutually beneficial. Here great caution is needed, since the so-called "red spider," justly dreaded in vineries, is a member of the same order. We must therefore regret that Dr. Lundström, or his abstractor in *Humboldt*, has not given us the names of the species which he has studied. We suspect that they must belong to the families of *Trombididæ* or *Ganasydæ*.

A mite, it must be remembered, though a tiny creature is by no means an insect, but is much more nearly related to the *Crustacea* (crabs, shrimps, etc.) and to the *Arachnida* (spiders, scorpions, and the like).

Lundström has noticed that on the underside of the leaves of the lime, alder, elm, hazel, and plane there are found at the junctions of the nervures little tufts of hairs. These form dwellings in which the light-dreading mites spend the day. Here they are born, grow up, and die. An anatomical examination of the leaves shows that in these hiding-places both the epidermis and the underlying assimilative tissue differ plainly from other parts of the leaf. Not merely the form, but the contents of the cells seem here peculiar. These facts place it beyond doubt that we have here a mutual relation between the leaf and the mite; in short, a phenomenon of adaptation. Turning to other plants, Lundström found in them also identical or, at least, analogous relations. Thus, in *Lonicera xylosteum* and *L. alpigena*, the mites occupy minute, peculiarly-shaped pits or pockets on the lower surface of the leaves; in the ash (*Fraxinus excelsior*), they dwell in a groove in the rachis; in the gooseberry and in *Ribes alpinum* we find colonies of mites in pocket-like structures at the base of the lower side of the leaf. Among tropical plants, especially in the *Rubiaceæ*, cases of such association with mites were much more frequent.

Lundström then inquired whether these peculiar arrangements pre-existed in the plants, or whether they were subsequently occasioned by the mites, and further, what advantage, if any, the plants could derive from this living in common (symbiosis). He therefore raised plants from seed in such a manner as to be absolutely free from mites. To his surprise many of the seeds did not germinate. When he finally succeeded in getting young plants perfectly without mites, he still found the peculiar structures—pits, pockets, folds, tufts, etc.—whence he infers that they are not of a morbid character. Still, he observed that if the plant is kept for a considerable time perfectly free from mites, these habitations do not become perfectly developed, and are even reduced in number. Hence Lundström conjectures that they were originally occasioned by the action of the mites, being consequently of pathological nature, but have since become hereditary.

To determine the importance of the mites for plants it was necessary to inquire into their functions. Lundström finds merely that they eat, excrete, and breathe, giving off carbonic acid. If it be asked, What is their food? he finds that it is not the juices of the plant, but the spores and hyphae of fungi. Hence they protect the plants which they inhabit against the attacks of parasitic fungi—surely a service of no trifling importance.

They are useful to plants, further, by their nitrogenous excretions, and by the carbonic acid which they exhale. For, as it has been already remarked, the assimilative tissue lying immediately under the habitations of the mites is often different, both in form and contents, from similar tissue in other portions of the leaf. But further, Lundström has succeeded in proving directly that the excrements of the mites gradually vanish down to a thin film. It seems to him not improbable that the subjacent cells secrete an agent which dissolves the excrements and renders them capable of absorption and assimilation by the cells. This would seem to show that the carnivorous plants are not alone in being able to utilise complex organic food without its previous decomposition into ammonia or oxides of nitrogen.

That the carbonic acid exhaled by the mites is serviceable to the plant Lundström infers from the circumstance that those parts of the leaves which are tenanted by mites remain green longest in autumn.

In conclusion, Lundström gives a conspectus of symbiotic formations. Under this name he includes all structures in plants occasioned or established by foreign organisms, and in which such organisms undergo an essential part of their development. According as the symbiosis (association) is antagonistic or mutual, the formations produced are called *cecidia* or *domatia*.

It will be apparent from Dr. Lundström's researches that the mutual relations of plants and animals have not all been thoroughly explored. Further investigation in this direction is needed, and will doubtless reward the patient observer with discoveries concerning the economy both of animals and plants.

THOUGHTS ON INSTINCT.—II.

(*Concluded from p.* 495.)

IN thus acting there can be nothing unphilosophical. But we are bound to find out, if possible, what is this unknown power. We must ascribe to it no more than is plainly needful. We must note, too, that the instinctive shrinks up and draws back on close examination. In other words, many actions which were once called instinctive are now found traceable to instruction, imitation, or to knowledge otherwise acquired, or, finally, to the teachings of reason.

It has also been shown that much of what, in the actions of the lower animals, seems to us inexplicable is due to the greater acuteness of their senses, or, in case of insects, to their possession of senses, other, or even more, than our own. That many vertebrate animals far surpass us in the delicacy of their sight, smell, or hearing is no longer a matter under discussion. As for insects, a variety of points connected with their structure, and, still more, a number of observations upon their conduct, almost compel us to admit that they possess inlets of knowledge of whose nature we can form no direct conception.

Within the domain of sight there are regions closed against us. The retina of the human eye is sensitive to a portion only of the sun's rays. If we throw the solar spectrum upon a screen, we see the seven so-called spectral colours in their usual order. But above and below these bands of colour there are radiations whose presence we can show by appropriate physical and chemical means, but which, to our organ of sight, are simply darkness. If the eyes of any creature—or its entire frame—be sensitive to the whole or to a part of these "dark rays," as we call them, such creature will be able to see where we find total darkness, and to see illuminated objects as we do not see them. If, then, certain animals possess more acute and perhaps more numerous senses than do we, they are in a condition to acquire by direct perception knowledge which we can gain only by trains of inductive reasoning, and by the use of instruments of precision. Very probably most of those instances of alleged instinct which are not resolvable into hereditary habit depend on a simple following of the guidance of senses more acute than our own. We must never forget that to all animals, and not less to uncivilised man, every strange object is unpleasant, and is either attacked or fled from according to circumstances.

Trappers in the Rocky Mountains declare that even the redoubtable grizzly, if the scent of a man is brought down to him on the wind, becomes uneasy, and quickly gets out of reach of the unknown impression. When a bun, wet with prussic acid, was thrown to a superfluous bear in the *Jardin des Plantes*, we were treated to much high-flown declamation because the animal, instead of at once devouring the bun, first washed it in a little channel of water flowing through his enclosure. Now this action was plainly due, not to any instinctive knowledge of the properties of prussic acid, but simply to the bears' distrust of an unusual smell.

That acquired habits may become hereditary, reappearing without any special instruction or example in succeeding generations, is shown by such familiar instances as the pointer, the retriever, and and the sheepdog. Bird's-nests have been vociferously appealed to as instances of a mysterious instinct. Say the rhetoricians:—"It cannot be imitation, for, though you hatch a crow under a hen and never let it see any of the works of its kind, the nest it makes will be the same, to the laying of a stick, with all the other nests of the same species. It cannot be reason; for were animals endowed with it *to as great a degree as man* (note the sophism!), their buildings would be as different as ours, according to the different conveniences they would propose to themselves."

This sounds, to the non-naturalist, very plausible. But we are perfectly warranted in referring the general similarity of the nests of any one species to hereditary habit. The second part of Addison's argument is sophistical:—"It cannot be reason; for were animals endowed with it to *as great an extent as man*," etc. This is what no one contends; observers of Nature maintain that the lower animals are endowed with it to a *much less* degree than is man, such a less degree being fully sufficient.

Further, as Mr. A. R. Wallace has ably shown, the habitations of birds are modified according to circumstances. We even learn that the European sparrow, introduced into North America, builds itself there a winter-nest for shelter during the inclement season, quite different from its breeding-nest. On the other hand, man, in the construction of his dwellings and in many other matters, often evinces an adherence to hereditary customs, little in accordance with reason.

The region where in addition to actions evidently rational we meet with others for which reason does not at first sight seem to account is the insect world. As we find so much difficulty in comparing the senses of invertebrate animals with our own, we are still less able to fathom their mental nature. To pronounce their actions "instinctive" is, therefore, an indirect and not over candid way of confessing, and at the same time shuffling, over our own ignorance. Far better to make a bold avowal of our limited knowledge, and strive patiently and earnestly for its extension. The instinctarian of the old school does neither.

Perhaps it will be found that the finishing stroke to the doctrine of instinct, viewed as a mysterious substitute for reason, has been dealt by the elder Darwin, and has again been brought under notice by Mr. Samuel Butler. These writers pronounce instinct to be simply "inherited memory." Each animal is simply a continuation, or, as Dr. Darwin expressed it, a "prolongation," of the life of

its parents. It has a latent memory of their habits and actions, which may be called into play by the stimulus of circumstances. The possibility of latent memory cannot be disputed. It often happens that we have forgotten a name, a fact, an event, or a project, when some casual incident, perhaps of a quite irrelevant nature, brings it fully to our recollection.

In a similar manner, according to Mr. S. Butler's theory, when a pair of young birds have mated, the latent memory of the nest-building art which they inherit from their forefathers is called into action. Or the female solitary wasp, when about to oviposit, becomes conscious of the architectural traditions of her species, of which she had previously only a latent unconscious knowledge.

This explanation, if it can be reconciled with all the facts of the case, must complete the long wished for decomposition of the instinct hypothesis, notwithstanding those phrenologists who allege that they have discovered an "organ of instinct" in the brain of certain animals.

EXCEPTIONAL METEOROLOGY.

FOR the last two or three years there has been exceptional weather over a large area of the northern hemisphere, with excessive rain, causing floods. These excesses are not uncommon, when time is considered, as history details such at intervals of centuries; and geology indicates similar excesses during cycles of centuries. Wide variations in the seasons over the earth's surface can only come from cosmical causes, the prime source of heat being the sun. Our earth only receives a small fractional part of the sun's heat; but, whatever that may be in the year, more or less than the average, the entire surface of our earth must feel and be subject to the effects. And one thing is certain—namely, that a year, or series of years, of excessive sun heat will inevitably be years and seasons of excessive atmospheric disturbances, because increase of heat will produce excess of evaporation, excess of electric action, and, necessarily, excessive precipitation; and, during a prevalence of this excess of sun heat, there must be over limited areas violent storms both summer and winter.

A high temperature over sea and land will produce an excessively vapour-saturated atmosphere, beneath a colder atmosphere above, making, during a calm, a dangerously unequal balance, as there may be a lower stratum of atmosphere at upwards of 100 degrees of temperature, holding in solution transparent vapour, containing near 1,000 degrees of latent heat. When, therefore, very large areas of the atmosphere have been, by excess of heat, brought into an unequal state, as large areas of lower stratum of highly heated air and vapour, which is also intensely electric, the conditions to produce sandspouts, waterspouts, and tornadoes are fully ripe. The upper and colder layer of the atmosphere cannot cool the lower highly heated and vapour laden stratum so evenly and quickly as to prevent vents in the form of funnels forming from the lower stratum to the higher stratum, and causing a rupture which takes place upwards in a pipe-form, just as water in a tank or basin, having a bottom means for discharge by a pipe, flows out with a whirling motion—in our northern hemisphere always in the direction of the hands of a clock, and so the heated, highly electric, and excessively vapour laden atmosphere breaks into the cold atmosphere above when at the level of the "dew point," invisible vapour becomes visible, parting with its latent heat, which so rarifies the air as to force some of the condensed atmosphere in visible cloud mounting thousands of feet above the condensing dew point, and into a region above the highest peaks of the highest mountains; and to feed this pipe, or, as in some cases, pipes, the lower stratum flows in from all sides to rotate and ascend with the intense velocity of steam power, sufficient to produce all the disastrous effects of the wildest tornado, there being almost a vacuum at the ground, or water line, as the phenomenon may be on the land or over the sea. On the land trees are twisted and uprooted, houses are unroofed, solids of various kinds are lifted from the earth, and human beings have been blown away like dead leaves. There are, also, records of railway waggons having been blown off the rails. In deserts, entire caravans have been buried beneath a mountain of blown sand, camels, horses, and men; while in Egypt there are the ruins of cities, massive temples, and monuments deep buried in the adjoining desert sand. At sea many a good ship caught by a tornado has been overwhelmed and sent to the bottom whole.

These violent tordado storms are intensified types of storms in general, which may be more miles in width than a tornado is yards, but there is a similar process, a flowing in from all sides towards a revolving centre with an upward flow of heated air to the dew point of condensation, and an out and over roll above of visible vapour, giving a high barometer over large areas all round the storm, with fog. There are, however, milder forms of the described action, producing on a warm summer day the cumulus clouds. Here the lower stratum of warm air is also flowing inwards and rising upwards beneath each cloud, condensing at the dew point, parting with latent heat, producing modified steam power, and so causing these summer clouds to enlarge upwards, bulge, and mount in sunshine like illuminated Woolpack Mountains.—*The Times.*

Reviews.

The Natural Law of Relation between Rainfall and Vegetable Life, and its Application to Australia. By Franz A. Velschow, C.E. (of Copenhagen). London: Stanford.

Are certain regions of our globe barren, or at least poor in vegetation, from the paucity or the irregularity of the rainfall? Or is the drought the consequence of the deficiency of vegetation, or of the presence mainly of such trees and shrubs as are of a desert type? Which of the two sets of phenomena is cause, and which is effect? Common opinion asserts that rainlessness gives rise to treelessness, and that if we could pour down upon the Sahara, upon Arabia, and the central regions of Australia, a yearly and evenly distributed rainfall of 50 or 60 inches, we should see them covered with a luxuriant vegetation.

Our author takes the opposite view. He considers that the regions in question are arid either because their forests have been recklessly felled, burnt down in times of war, and destroyed by goats, which Sir Joseph Hooker pronounces to be worse ravagers then war. Or, where there has been no such general and wide-spread destruction, the natural vegetation, as in Australia, is not of

a kind which keeps up a vigorous evaporation, and thus promotes rainfall.

In support of his contention, he shows that watery vapour rarefies the atmosphere instead of, as now supposed, increasing its specific gravity—a fact which, as it is incidentally mentioned, explains why the barometric measurement of the height of mountains generally proves a failure, even in the most experienced hands. Over dried-up land there seems to lie a dry air-cushion, unless the exhalation of moisture from vegetation promotes a circulation in the layers of the atmosphere, thus enabling the moist air of the upper regions to approach the surface and come down as rain. Mr. Velschow maintains that the Australian vegetation has a low degree of evaporating power, and that to this circumstance is due the irregularity of the rainfall. An improvement would be possible if a vegetation having a high degree of evaporating power could be superadded to, or to some extent substituted for, the existing flora. No one certainly would complain if the Spinifex were displaced. Our author proposes the experiment of planting belts of deciduous trees extending gradually from the coasts towards the interior.

We may now glance at some facts which tell in favour of Mr. Velschow's theory. We need not attempt to prove that the countries forming the Mediterranean basin—those especially at its eastern and southern boundaries—have become less fruitful and populous than was formerly the case, and that they have simultaneously been disforested. Now, as the decreasing fertility is closely connected with a diminished rainfall, and occurs only where water is absent, there is at least *primâ facie* evidence that the destruction of the woods has been the cause of the mischief.

On the other hand there are facts which, to us, seem to speak on the opposite side. There are two belts of droughty land running round the earth, one in either hemisphere, interrupted only where they are intersected by high mountain-chains, by great rivers, or by the sea. The northern zone may be traced in the south-western States of the American Union, especially the regions formerly pertaining to Mexico. On this side of the Atlantic it reappears in Africa, forming the Sahara, passing over into Arabia and Persia, and then turning mainly into Central Asia, although certain regions of India sadly require a more ample and more regular rainfall.

In the southern hemisphere we find an analogous zone. It is strongly manifested on the western slope of the Andes, in Chili, Bolivia, and Peru; it extends eastwards over a great part of the Argentine territory; we meet it again in Southern Africa, and lastly in Australia. Now, it must seem strange that if these "rainless" tracts depend on any peculiarity of the vegetation, they should encircle the globe with such regularity.

Mr. Velschow mentions the absence of lofty mountain ranges in Australia as being a circumstance in favour of a copious and regular rainfall in Australia. This, to say the least, is a very doubtful point. We hope that the author's theory may prove correct, and we should strongly advocate the experimental plantings which he recommends. It is to be noted that Baron Von Müller, botanist to the Colonial Government of Victoria, recommends that the deserts should be attacked by pushing forward belts of fig-trees, followed up by less hardy plants, but the fig-tree gives off very little water from its broad, leathery leaves.

Nature's Hygiene: A Systematic Manual of Natural Hygiene, containing the Chemistry and Hygiene of Eucalyptus, Pine and Camphor Forests, and Industries connected therewith. By C. T. Kingzett, F.I.C., F.C.S. Third edition. London: Baillière, Tindall, and Cox.

The first edition of this work was devoted mainly to an exposition of the sanitary efficacy of the eucalyptus, the pines, camphor, and the essential oils, as well as to the process of the manufacture of "sanitas" by oxidation. In the second and in the present edition we find also chapters on water supply, sewage, infectious diseases, and the treatment of the sick, thus forming a general sanitary manual. These subjects the author for the most part treats in a very able and judicious manner. He sets out with an exposition of chemical principles. He describes some of the more important elements and their modifications and compounds. Especial attention is given to ozone, which he tells us, upon the authority of Dr. A. R. Leeds, has little action upon the colours of flowers and to hydrogen peroxide. He lays the greater emphasis upon the latter compound as it is generated by oil-producing plants, and thus fulfils an important sanitary function. He then passes over to a consideration of the air, respiration, and ventilation. Here we find a curious error, clerical or typographical. It is said that "A cubic foot of air weighs at 60° F. and 30 *metres* Bar. 536·96 grains." The writer evidently meant to say "30 inches."

On the subject of water-supply we meet with an argument which we cannot accept. Says the author:—"The mineral (inorganic) constituents, however, are otherwise unobjectionable in drinking water; it is only the organic matter that may render the water unfit for potable purposes. A general support is given to this statement by the well-known fact that so-called 'mineral' waters are taken on account of their reputed medicinal value, which is due to the salts that are present in large quantities."

Very true, but a substance which may be taken with advantage in peculiar states of the body, and under medical advice, is not on that account fit for general use by persons in health. Not to speak of lead which sometimes finds its way into drinking-waters, salts of magnesia are often present in unsafe proportions.

Mr. Kingzett does not accept the somewhat exaggerated view of the late Rivers' Pollution Commission, that "Rivers which have received sewage, even if that sewage has been purified before its discharge, are not safe sources of drinking-water." He adduces good evidence to show that sewage is actually destroyed in rivers. Of course, if the proportion of the impurities is excessive, and if, as in the streams of Lancashire, the West Riding, and the Glasgow district, fresh contributions of pollution are introduced every half-mile, the water must remain foul. But for the further discussion of this interesting question, we must refer our readers to the original work.

The process by which it was hoped to deal with the London sewage, viz., storing it up during the flow of the tide in large reservoirs, and letting it out during the ebb, is condemned in very plain language. A similar judgment is pronounced upon the recent "deodorising" experiments of the Metropolitan Board of Works. The author considers, very rightly, that "The sewage of London not merely demands chemical treatment, but the clear effluent alone should be discharged into the sea at Barking and Crossness."

The project for conveying the sewage entirely to the

Essex coast, and pouring it into the North Sea, is indefensible from any point of view. Worse, if possible, is the scheme of precipitating the sewage and conveying the sludge out to sea in lighters.

As regards sewage irrigation, the author admits that—leaving other difficulties on one side—there is not in this country sufficient suitable land available for disposing of sewage in this manner.

We cannot, however, agree with Mr. Kingzett when he asserts that precipitation processes require the use of "expensive chemicals in large quantities." If such materials as peat, clay, carbon—one form of which the author has patented in combination with clay—are made to take part in the work of purification, very little remains to be done with even cheap chemicals.

A few typographical errors have escaped correction. Thus in one place Mr. Bailey Denton figures as "Mr. Barley Donton."

"Nature's Hygiene" is not merely a readable book, but contains much that is worthy of serious consideration, even by official sanitarians.

TECHNICAL EDUCATION IN FRANCE.

IN the lowest classes of the elementary schools, children who may be only six years old receive three lessons a week, of one hour each, in handicraft. From ten years of age until graduation the children pass eighteen hours a week in the shop. In the ordinary primary schools the authorities of the city of Paris teach advanced drawing from models, not from the flat, and the use of ordinary tools for working wood and iron, without attempting to teach special trades. In nearly fifty schools this experiment is in progress. There are also the municipal apprenticeship schools, the most famous being in the Boulevard de la Villette, founded in 1872. That is a school for teaching boys to use machines and tools. The boys enter at fourteen. During the first two years they work four hours in the school and six in the shops; afterwards two hours in the school and eight in the shops. This school is thus a veritable trade one, and a substitute for the apprenticeship system, which is fast disappearing throughout the industrial world. Then in France, as elsewhere, there are the semi-trade schools, which have been established by the great manufacturers. In such schools generally attention is given to proficiency in drawing, modelling, elementary mathematics, and the elements of physical science, and at evening classes an attempt is made to remedy day-school deficiencies and neglected education.

Since 1882, in France, manual labour and technical training are included in the compulsory subjects of primary education. As yet the general organisation is incomplete, but for the most part it is at work in the large towns and in the training schools for teachers. Then a number of towns, notably Rouen and Havre, have established apprenticeship and professional schools, where pupils remain until sixteen or seventeen years of age. This training qualifies them for readily obtaining trade employment at two-thirds of skilled wages. On this last-named point of trade employment some interesting facts are available from the experience of the city of Paris apprentice school, L'Ecole des Apprentis. Taking a pupil from entrance to termination, there is, to begin with, no admission under thirteen years of age, and then only with an elementary knowledge certificate. Next, for three years the course of instruction for half the day is in schooling, and for half the day at practical work in one or other of the shops. So trained, boys at sixteen are able to take rank at once as skilled workmen, and to earn the usual wage of the ordinary untrained workman, and not unfrequently of the average workman of full age. The promoters of the school have regarded the subject in a scientific spirit, collecting much instructive data. The school was founded in 1873. Of seventy-four apprentices who had gone out up to August, 1887, sixty-nine remained faithful to the industry taught them in the school, their average earnings on leaving being 18s. a week of fifty-six hours; while their average age was seventeen and a half years. Among them the young smiths and metal-turners earned more, getting from 20s. to 32s. a week at the outset. The school has a graduated series of manual exercises, designed to develop skill, without reference to industrial profitableness. No work is attempted under such exercises until the how and why have been explained, nor until such work has been made the subject of a proper working drawing. Meanwhile regular technical and scientific principles are taught and insisted on in the shops. This broad instruction is given under the direction of competent teachers, the head of the shop being himself a former pupil of the Arts et Metiers, known to be imbued with science enthusiasm, and the teacher of physics comes from the Paris Observatory. M. Muller (the Director) conducts classes in descriptive geometry and other subjects. M. Bocquet (Superintendent of Workshops) gives a course of technology, beginning with tools and bits of machinery up to a complete knowledge of machines and machine tools. Drawing, applied physics, applied chemistry, algebra, arithmetic, geometry, and even industrial jurisprudence form parts of the general study. In the Paris school of the Rue Tournefort the children are taught as if they had been apprenticed. They number nearly 400. Trade instruction lasts from ten years of age up to thirteen. In the first two years the instruction is in generalities, in the third year work is specialised, when, the child's bent having been discovered, he is put to modelling and carving, or to joinery and cabinet-making, or to smith's work in forging and fitting. Then the pupils work in shops, where they receive instruction in drawing, geometry, and natural science. In the school of the Christian brothers, Rue Vaugirard, there are workshops, wherein are taught gilding, wood and stone carving, trunk-making, shoemaking, tailoring, weaving, bookbinding, mathematical instrument making, etc., so that when the school is left a useful calling may be followed, presumably not at the highest current wages, but as leading up thereto.

PHOTOGRAPHY UNDER WATER.—M. Forel finds (*Siècle*), by a series of interesting experiments made in the Lake of Geneva, that photographic action extends to a depth of 45 metres in summer, and of 100 metres in winter. The reason of this unexpected difference is that the water in summer is much more contaminated by suspended matter than in winter. According to the same authority, white discs can be seen in winter to the depth of 20 metres, whilst they cease to be visible at 5 or 6 metres in summer.

HONOURS TO DESCARTES.—M. Janssen (*Comptes Rendus*), referring to the recent celebration at Cambridge of the bi-centenary of the publication of Newton's "Principia," suggested a similar demonstration in honour of Descartes.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on May 17th, Professor J. A. Ewing, F.R.S., Professor of Engineering in University College, Dundee, and Mr. G. C. Cowan, read a paper on the "Magnetic Qualities of Nickel."

The experiments described in the paper were made with the view of extending to nickel the same lines of inquiry as had been pursued by one of the authors in regard to iron. (Phil. Trans. 1885, p. 523.) Cyclic processes of magnetisation were studied in which a magnetising force of about 100 c. g. s. units was applied, removed, reversed, again removed, and re-applied, for the purpose of determining the form of the magnetisation curve, the magnetic susceptibility, the ratio of residual to induced magnetism, and the energy dissipated in consequence of hysteresis in the relation of magnetic induction to magnetising force. Curves are given to show the character of such cycles for nickel wire in three conditions: the original hard drawn state, annealed, and hardened by stretching after being annealed. The effects of stress have also been examined (1) by loading and unloading magnetised nickel wire, with weights which produce cyclic variations of longitudinal pull, and (2) by magnetising while the wire was subjected to a steady pull of greater or less amount. The results confirm and extend Sir William Thomson's observation that longitudinal pull diminishes magnetism in nickel. The diminution is surprisingly great: it occurs with respect to the induced magnetism under both large and small magnetic forces, and also with respect to residual magnetism. The effects of stress are much less complex than in iron, and cyclic variations of stress are attended by much less hysteresis. Curves are given to show the induced and residual magnetism produced by various magnetic forces when the metal was maintained in one or another of certain assigned states of stress; also by loading and unloading without alteration of the magnetic field. Values of the initial magnetic susceptibility, for very feeble magnetising forces, are stated, and are compared with the values determined by Lord Rayleigh for iron, and the relation of the initial susceptibility to the stress present is investigated. The paper consists mainly of diagrams in which the results are graphically exhibited by means of curves.

A paper "On Æolotropic Elastic Solids," by Mr. C. Chree, M.A., Fellow of King's College, Cambridge, was communicated by Professor J. J. Thomson. This paper is concerned with certain problems involved in the equilibrium or vibration of various forms of elastic solid structures. The case of a beam fixed at one end and acted on by a system of forces at the other, was elaborately treated by Saint-Venant. He, however, started with certain assumptions, and one of the objects of Parts I. and II. of this paper is to treat this important problem from a point of view independent of such assumptions. The results obtained agree with Saint-Venant's.

It is shown how, in most materials whose properties in different directions are different, a circular bar when twisted round its axis by forces at the ends must become warped, and when exposed to pulling forces over its ends must slightly alter the form of its cross section. The variety in the character of these phenomena would allow the nature of the material to be determined.

In Part III. the effects of rotating a spheroidal body about its axis of revolution are completely investigated, and it is shown how the results may be extended so as to apply to a thin circular disc rotating about a perpendicular to its plane through its centre, and to a long thin cylinder rotating round its axis. The disc is shown to increase in radius and to diminish in thickness, especially near the centre, so as to become bi-concave. The long cylinder tends to shorten, while its ends remain flat.

Part IV. deals with the longitudinal vibrations of a circular bar of a material symmetrical round the axis. It does not, as is usually done, assume the bar to be indefinitely thin, but obtains an expression for the frequency of the fundamental note and its harmonics, the degree of whose accuracy is explicitly determined. It is pointed out how the conclusions of the ordinary theory diminish rapidly in accuracy as the ratio of the diameter to the length of the bar is increased, and the higher the order of the harmonic the more serious is the error.

A paper on "The Electric Organ of the Skate," by Professor J. C. Ewart, was also read, a notice of which we give on page 508.

LONDON MATHEMATICAL SOCIETY.

At the meeting held on Thursday, May 10th, Sir J. Cockle (President) in the chair,

Mr. E. B. Elliott read a fourth paper on "Cyclicants or Ternary Reciprocants and Allied Functions."

Mr. Cook Wilson gave a sketch of "Some Theorems on Parallel Straight Lines together with some attempts to prove Euclid's Twelth Axiom." A long discussion ensued, in which Messrs. Henrici, Elliott, Buckheim and the author took part.

The following papers were taken as read: "On the Flexure and the Vibration of a Curved Bar," by Mr. H. Lamb; on the "Figures formed by the Intercepts of a System of Straight Lines in a Plane, and Analogous Relations in Space of Three Dimensions," by Mr. T. Roberts; on "Lowe's Differential Equation," and on "Stability of Orbits," by Professor Greenhill.

ROYAL INSTITUTION.

A lecture in French was given on Friday, May 18th, in the theatre of the Royal Institution by M. Alphonse Renard, LL.D., etc., Curator of the Royal Museum of Brussels, on the formation of volcanic rocks. By means of the oxy-hydrogen light a large number of illustrations were thrown on the screen, showing the progress of crystallisation in vitreous rocks and the many curious forms they assume, according to the degrees of heat or other circumstances present during their transformation from amorphous matter to the crystalline states, into what are known as crystallites. Other views showed lava in surging activity, carrying along already long-formed crystals, breaking, corroding, and melting. After the limit of the power of observing with the naked eye had been reached, the microscope was brought in to reveal the minutest details of the admirable texture of the volcanic masses. The lecturer explained the means by which Sir James Hall, Gregory Watt, Fouqué, Michel Levy, and other experimenters were able to develop all the required degrees of temperature, from dark red to blinding white, and to maintain the temperatures for indefinite periods. In spite, he said, of the splendid achievements of synthetical geology, success was still incomplete. Rocks containing mica, quartz, hornblende,

and the acid rocks in general, so far defied their efforts, but the lecturer expressed the opinion that the time would come when the rocks which were at present proof against the efforts of science would be reconstituted. Thus would be crowned the work of which Leibnitz had already, two centuries ago, obtained a view, for he wrote, "The man who will compare carefully the products wrenched from ths depths of the earth with those of the laboratory will do a great work."

THE ROYAL SOCIETY OF EDINBURGH.

At the meeting on May 7th, Lord M'Laren, Vice-President, in the chair, a paper on the secretion of carbonate of lime by animals, by Mr. Robert Irvine and Dr. G Sims Woodhead, was read by the latter. The special importance of the investigation was spoken of in connection with marine fauna and flora. A hen had been taken for the purpose of observation, and it was found that sulphate of lime could be converted into the carbonate of lime which forms an egg-shell. The process of secretion of carbonate of lime from the lime altered by digestion were described. Dr. Alexander Bruce described investigations in a case of absence of the corpus callosum in the human brain, in which he took up a position antagonistic to the views of Professor Hamilton, Aberdeen. It was explained that the subject, a man, had been a little stubborn in character, and had given way to alcohol. Dr. John Murray submitted investigations as to the distribution of some marine animals on the west coast of Scotland. The leading results showed that many of these animals were what would be properly called deep-sea animals, usually abundant in depths beyond 100 fathoms. Dr. Murray also spoke of inquiries he had made into herring life. He said that while the west coast fishermen talked about the herring "coming in," there was no direct evidence that the herrings ever came in round the Mull of Cantyre to the Firth of Clyde; and it would be found that the fishermen meant that they were coming in from the deep water towards the shore. Again, they would be able to account from the food how it was that the herring in one loch were different from the herring in another. A paper on the solubility of carbonate of lime under different forms in sea water, by Mr. Robert Irvine and Mr. George Young, was read by Dr. Murray; and Mr. W. E. Hoyle made a statement on the larvæ of certain crustacea from the Firth of Clyde.

ROYAL METEOROLOGICAL SOCIETY.

At the meeting held on May 16th, Dr. W. Marcet, F.R.S., President, in the chair, the following communications were read:—

1. "Report of the Wind Force Committee on Experiments with Anemometers Conducted at Hersham," by Mr. G. M. Whipple, B.Sc., and Mr. W. H. Dines, B.A. A whirling apparatus, with arms 29 ft. radius, was rotated by means of a small steam engine. On the arms of the whirler four different anemometers were placed. Each experiment lasted fifteen minutes, the steam pressure remaining constant during the run. For the Kew standard anemometer, with arms 2 ft. long, the experiments give a mean value for Robinson's factor of 2·15; and for two smaller instruments the factor is 2·51 and 2·96. Mr. Dines's helicord anemometer gave very satisfactory results, the mean factor being 0·996.

2. "On the Measurement of the Increase of Humidity in Rooms by the Emission of Steam from the so-called Bronchitis Kettle," by Dr. W. Marcet, F.R.S. The author described a number of experiments which he had made by steaming a room with a bronchitis kettle, and ascertaining the rise and fall of the relative humidity from readings of the dry and wet bulb thermometer. He found that the air in the room could not be saturated, the relative humidity not exceeding 85 per cent.

EGYPT EXPLORATION FUND.

A meeting in connection with the Egypt Exploration Fund was held on May 9th, Sir T. Fowler in the chair, when a lecture, illustrated with limelight views, was delivered by Miss Amelia B. Edwards on M. Naville's recent discoveries at Bubastis.

The Chairman, in opening the proceedings, remarked that that was the first time they had met as a corporate body. He therefore took that opportunity of saying that their object was not the discovery of curiosities, but the elucidation of ancient Egyptian history, and especially that of the Old Testament.

Miss Amelia B. Edwards said that it was in order that they might form some idea of the objects discovered since they last met that they had been invited there that evening. M. Naville resumed work at Tell Basta, the ancient Bubastis, on the 23rd of February last. The old diggers of last year came back eager for employment, and in a few days the tents of the explorers were planted on the old ground, the mounds were once again swarming with fellaheen, and the air was alive with the monotonous singing of the girl carriers and the deep hum of hundreds of men's voices. The work went on apace, and in the course of two short months a vast number of important discoveries were made. The two large pits of last year were first of all thrown into one, and the ground was then cleared from east to west following the axis of the temple till the whole width of the building was laid bare. A third hall (built by Osorkon I.) had been discovered. It was of red granite and lined with sculptural slabs. The remains of a colonnade had also been discovered, and at the western end, where the sanctuary lay entombed, some fragments of a beautiful monolithic shrine in red granite were discovered. The results of the investigations this year had brought up the number of Pharaohs to the magnificent total of no less than twenty-two royal names. Most surprising and precious of all the discoveries were an architrave sculptured with the cartouche of Apepi and the remains of three priceless statues of the Hyksos period. The Hyksos sculptures of Bubastis were remarkably fine and extremely important. They were all three statues of kings. One of these, which was unfortunately headless, was seated on a throne inscribed with his family name, his throne name, and the so-called "banner" name of royalty. This was the first occasion upon which a Hyksos statue had been found with a legible inscription. The names and titles of this Hyksos king were as sharp as if chiselled but yesterday by the lapidary scribe. It was conjectured that this king, whose name was Raian, was Joseph's Pharaoh, this name being all but identical with the name which Arab tradition gave to the king in whose time Joseph was brought to Egypt. Among the objects exhibited by means of the limelight was a head which the lecturer described as one of the most beautiful ever discovered in Egypt. It was of red granite, and re-

presented Rameses II. as a young man, crowned with the plumed and winged helmet known as the Astef crown. Over his brow was the *uræus*, or sacred basilisk, the emblem of sovereignty. A row of smaller basilisks surrounded the lower part of the helmet, and above those was the sun disc between the twisted ram's horns of the god Knum. No such sweet and attractive portrait of Rameses II., or, indeed, of any other Pharaoh, was known. This beautiful head is now in the Boulak Museum. Another slide exhibited a most perfect Hathor-head capital. This head was as fresh as the day when it left the hand of the sculptor. There was not a scratch upon the soft and rounded cheeks, and not even the tips of the little heifer-ears were broken. This was a work of the reign of Osorkon II., who added a series of Hathor-head capitals, with very questionable taste, to the grand lotus-bud columns of the Hypostyle Hall. This head had been ceded to the Egypt Exploration Fund by the Egyptian Government. At the conclusion of her lecture Miss Edwards made an earnest appeal for funds in aid of the work of rescuing these discovered remains from the destruction which they would certainly meet with if not removed.

ROYAL HORTICULTURAL SOCIETY.

At the last meeting of the Scientific Committee Mr. Henslow observed that, with regard to Mr. Burbidge's remark at the previous meeting, that "the scarlet runner does not set its fruit in South America, but in this country it fruits freely, owing to the bees, which bore through the base of the flower," this was an error, as no flower is benefited by the perforations made by insects from without. The bees fertilise them, however, in the legitimate way; but in their absence the scarlet runner can scarcely fertilise itself. The French bean, on the other hand, is quite self-fertile, as horticulturists can force it in winter.

Mr. Roupell sent a specimen of *Sphinx ocellata* in illustration of "mimicry," the dull colour of the upper wings approximating to that of the dead leaves of the apple, on whose branches it rested. This view did not find favour with the entomologists present.

Mr. Morris showed a fine specimen of *Cynomorium coccineum*, a curious parasitic plant from Gogo, whence it had been received from the Governor of Malta, Sir Lintorn Simmons. This is the fungus Melitensis of old writers, and was formerly valued as an astringent; indeed, so highly was it esteemed that the plant was placed under the protection of a special guard.

Sanitary Institute of Great Britain.—At the annual general meeting, held at the Parkes Museum on Wednesday, May 16th, Professor W. H. Corfield, M.A., M.D. (Chairman of Council), in the chair, a report was presented by the Council on the work of the Institute during the last year, and on the Congress at Bolton in the autumn of 1887. The Chairman gave an address, and the officers for the ensuing year were elected:—The President, His Grace the Duke of Northumberland, K.G.; the Trustees, Sir John Lubbock, D.C.L., F.R.S., Dr. B. W. Richardson, F.R.S., and Thomas Salt, Esq., M.P.

New Minor Planet.—Minor Planet No. 278 was discovered on the morning of May 17th by Dr. Palisa at Vienna. At 2.15 a.m. on that date, its position was right ascension 16 hours 8 min. 8 sec. (decreasing 56 sec. daily); North Polar distance 111 degs. 35 min. 12 sec. (increasing 1 min. daily).

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

BRITISH LICHENS.

In reply to the inquiries of "Lichen," in your issue of May 18th, permit me to say that if the book of Dr. Lindsay's he saw in the British Museum was his "Popular History of British Lichens," then your correspondent had in his hand the most popularly written book on lichens in the English language up to the present time. Sowerby's "English Botany," with supplement, of course furnishes the best illustrations, but as a hand-book on the subject Dr. Lindsay's is still the best we have, *i.e.*, of a popular character.

Dr. Lindsay's book is now upwards of thirty years old, and certainly its classification or arrangement is certainly very far behindhand, but that does not invalidate his description of species, as far as they go. If your correspondent can determine his findings better from Dr. Lindsay's book than from Leighton's "Lichen Flora," etc., let him do so, and he may find elsewhere the classification required. If all be obtained up to classification, the most recent form of that may be found, in part, at any rate, and at very small cost, in the pages of "Grevillea," vol. xv., 1886 and 1887. A new hand-book, such as "Lichen" desiderates, is undoubtedly needed, but the interest taken in lichenology has hitherto been so limited that the question has been, Would such a book pay for printing? Lichenology, of all botanical subjects, it must be admitted, is the most difficult to popularise, and little has been done in that way. The most popular and recent treatment of the subject we know of, in any natural history magazine, is that now being published by the Rev. W. Johnson, F.L.S., in the "Wesley Naturalist Journal." Beta.

THE COLD WEATHER.

The unusually low temperature of the winter and spring months of the last three years is not a little remarkable. I subjoin a list of the mean temperatures as recorded at Greenwich:—

	Deg.		Deg.		Deg.
1885.—Dec. ...	38·9	1886.—Dec. ...	36·5	1887.—Dec. ...	38·1
1886.—Jan. ...	36·2	1887.—Jan. ...	35·6	1888.—Jan. ...	37·8
,, Feb. ...	33·7	,, Feb. ...	38·8	,, Feb. ...	38·9
,, Mar. ...	39·6	,, Mar. ...	37·6	,, Mar. ...	38·0
,, Apl. ...	46·4	,, Apl. ...	44·1	,, Apl. ...	43·3
Five months	38.9		38·5		38·4

The average of forty-five years is:—

December	38·8 deg.
January	38·5 ,,
February	39·7 ,,
March	41·7 ,,
April	47·1 ,,
Five Months	41·2

Comparing these tables we shall find that during the last three winter-spring periods of five months the temperature has been nearly three degrees below the average. So far the year 1888 has been notable for its ungenial weather, and it forcibly recalls the unpleasant experiences of 1879, which was one of the coldest years on record, and yielded the worst harvest known. A Member of the Liverpool Astronomical Society.

BURNING OF THE ALEXANDRIAN LIBRARY.

In your issue for April 20th (p. 369) there is reference to the "ruthless burning of the books of the Alexandrian Library." I beg to submit that this tradition runs counter to internal evidence. The books were for the most part rolls, not of papyrus but of parchment, a material very sparingly combustible. Such rolls might be burnt up if thrust into a furnace, but they could not be used for warming baths as they would generate more stench than heat. Nor is it proven

that the library was still in being at the time of the Arab conquest. The probability is that when Bishop Cyril and his monks broke into and sacked the Serapeion, the books were thrown out as rubbish and have been buried under sand-drifts. There are rumours that after high winds sheets of parchment have occasionally been seen projecting out of the sands. R. E.

CONNECTION BETWEEN COLOURS AND TASTES.

Attention has lately been drawn to the connection between colours and sounds, but no one seems to think of a possible connection or relation between taste and colour. Yet it is found that in the vegetable world bitterness is, in numbers of cases, if not universally, connected with a yellow colour. As instances may be mentioned the *Eschscholtzia*, which is too bitter even for the slugs, the dandelion, the gentian, and many others. Even artificial yellow colouring matters, such as picric acid, are also bitter. The connection of a red colour in fruits with acidity is, of course, understood. J. W. S.

THE LANTERN FLY.

The statements of your correspondent "T." (SCIENTIFIC NEWS, p. 501) on the luminosity of this insect (*Fulgora lanternaria*) are very interesting. He, as an eye-witness, fully confirms the original account given by Madame Merian, against which merely negative evidence has been produced. The varied colours of the light are most important. Have we here to do with different species, or can one and the same insect vary its light under different conditions, or at pleasure? Never having had the opportunity of meeting with this insect living, I am quite at a loss. AN OLD ENTOMOLOGIST.

NATIONAL HEALTH SOCIETY.—The Duchess of Westminster distributed the certificates awarded after the examinations and ambulance lectures of this Society, at Grosvenor House, on the 28th ult. The Duke of Westminster presided, and in opening the proceedings said that the Society was one the importance of which could not be measured by the slender pecuniary support it had received, far too slender for the object in view. Nevertheless the Society had been of great use, not only in regard to actual work, but also in stimulating public interest on the question. It had been proposed to amalgamate the Parkes Museum of Hygiene with this and kindred societies. If this could be effected he would be happy to place at the disposal of the amalgamated bodies a site in Buckingham Palace-road, although he was afraid he could not altogether give it to them. The certificates having been distributed by her Grace, the proceedings terminated with a vote of thanks to the Duke for presiding.

CAMBRIDGE.—The names of candidates for the office of University Lecturer in Geography, with brief statements of their qualifications and of the methods they would propose to adopt, should be sent to Dr. Ferrers, Master of Gonville and Caius College, not later than June 5th. The stipend is £200 per annum, and the appointment is for five years, subject to confirmation by the Senate.

PARIS WATER SUPPLY.—According to *Industries*, Herr Ritter, of Neuchâtel, has made a proposal to the municipality of Paris to supply that town with water from the Lake of Neuchâtel, the level of which is nearly 1,000 ft. above that of Paris. The distance is about three hundred miles. The quantity to be supplied is 20 tons per second, and the estimated pressure at Paris, after deducting loss by friction in the supply main, is 50 lb. per square inch. The total energy therefore brought by water to the town of Paris would thus amount to over 8,000 h.p. in falling water, or say, 6,000 actual h.p. obtainable from water engines.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

DECANTING.—A decanting appliance has been patented by Mr. T. Latimer, of Wakefield, Yorkshire. The bottle is held in a cradle pivoted to a case which contains a compartment for a corkscrew. The case is supported by a stand, which can be used as a reading-desk.

IGNITING FUSES.—An appliance for igniting fuses of mining cartridges has been patented by Mr. M. Settle, of Bolton. The invention consists of a shield for covering both the end of the fuse and the platinum bridge carried by the insulated conducting wires, so that when a current passes, the fuse is ignited without exposing flame or sparks.

GUN BARRELS AND PROJECTILES.—An improvement in gun barrels, and projectiles for use therewith, has been patented by Mr. H. E. Newton, being a communication from Mr. Nobel, of Paris. The invention consists in constructing barrels with a choke-bore, to reduce the diameter of the projectiles as they pass down. The bore may be conical and rifled throughout. The cartridge-case contains several projectiles of different lengths, the heaviest being in front, the object being to produce different ranges and trajectories.

FIRE EXTINGUISHER.—A hand fire extinguisher has been patented by Mr. E. G. Maxwell, as a communication from Mr. W. Druyff, of New York. This invention relates to that class of hand fire extinguisher in which a plunger or piston is employed to eject any suitable liquid. In carrying it into effect the reservoir in which the piston works is provided at each end with a suitable cap to hermetically seal the contents, but instead of being screw-threaded, each cap is locked and unlocked by a simple half-turn, similar to a bayonet joint, thus rendering the piston rod and piston free to work with the least possible delay and trouble.

SEWAGE.—An improvement in apparatus for treating sewage has been patented by Mr. F. W. Lacey, Brentford. The invention has for its object the oxidation of the sewage, and consists in the introduction of the air into the sewage while it is being pumped from one level to another. To effect this a tap is introduced into the suction pipes of the pump, between the pump plunger and end of the suction pipe, so that the air is drawn with the sewage into the pump barrel, and this thoroughly mixed whilst passing through the pump and during its flow to the outfall. This method also supplies air to the air vessel as required, and can be regulated by an ordinary cock.

EXTRACTING GOLD.—An apparatus for the extraction of gold has been patented by Mr. C. D. Abel, being a communication from Messrs. Fisher and Weber, of Berlin. The finely-ground ore, mixed with water or a solution of salt, etc., is placed in a vat lined with amalgamated plates and containing stirrers. The plates are

connected to the negative pole of an electric generator, and the stirrers to the positive. On passing the current an amalgam is formed; when this operation is completed, the mass is discharged through a cock into a trough, in which grooved wooden rollers rotate. These rollers carry longitudinal carbon rods, connected with the positive pole of an electric generator, which cause the small globules of amalgam to unite together.

NAVIGATION OF AERIAL VESSELS.—An improvement in the propulsion and navigation of aerial vessels has been patented by Mr. W. N. Hutchinson, of Eastbourne. The invention has for its object to propel and steer navigable aerial vessels by centrifugal rotary blowing engines, and to enable aeronauts to change their altitude at will without loss of gas or ballast. From any form of balloon a long car is suspended carrying the steam engine and several of the air-blowing engines. Each of the latter is furnished with one two-channel pipe, one channel for aiding progress, the other channel at right angles for steering and changing altitude. It has one or two, as the case may be, single-channel pipes for the incoming air. The number of blowing engines employed varies with different balloons.

MECHANICAL MUSICAL INSTRUMENT.—A mechanical musical instrument has been patented by Mr. F. E. P. Ehrlich, of Leipsic, Saxony. The invention relates to a combined string and reed instrument, in which the strings and reeds are simultaneously sounded. Levers are pressed upwards by springs, and are governed by a perforated tune-sheet in the usual way. The hammer rises with the lever under the influence of a spring, and strikes a string; at the same time a rod is raised by the lever, and allows a spring to open one of the pallets, thus causing its reed to sound. The pallets and reeds are arranged in rows and oblique columns to economise space. Rods bear against springs in the pallet levers to ensure an air-tight closure. The wind is drawn through the reeds by a bellows.

VAPOUR BATH.—Mr. A. N. Mezzetti has patented a vapour bath. The case is composed of a box on castors with a hinged wooden top which forms the surface on which the patient sits on a chair. The box may be of any suitable size. Connected to the ends of the case are sockets to support tubular standards of any desired length. The standards support a covering, quadrangular in shape and having an aperture of the top surface for the head of the user to pass through. The covering is secured round the box by buttons and loops, and the frame carrying this cover can slide up and down the standards and be fixed at any height. When not in use it fits over the cover of the case, and can readily be adjusted when required. Leading into the case is a pipe provided with a tap, attached to which is another flexible pipe leading to the source of steam.

AN ELECTRIC SENTINEL.—We learn that Mr. D. Drawbaugh has devised a piece of electric apparatus which is to play the part of a self-acting sentinel. It is to be buried in the earth at outposts, and to be connected by wires with head-quarters. Military men question the practical value of an apparatus which may be set in action by a passing hare or rabbit.

TECHNICAL EDUCATION NOTES.

THE PEOPLE'S PALACE.—At the opening of the Workmen's Industrial Exhibition at this institution Sir E. H. Currie, in presenting an address to the Duke of Westminster, said that during the past winter about 200 day and 4,000 evening students had attended the various practical, technical, general science, and art classes in the adapted buildings on the site. With the new technical schools now rising up, and to be opened by September 30th, at a cost of building and fitting of £20,000, the gift of the Drapers' Company, the trustees hoped to provide for 500 boys in the day technical schools and 6,000 evening students. Already 4,000 young men and women, between the ages of fifteen and twenty-five, had joined the People's Palace Institute, and these numbers would be largely increased when the additional accommodation was provided for social purposes. This short statement, the trustee considered, would not be complete if he did not also mention the fact that the beautiful library, which would seat a very large number of readers and would be capable of holding a quarter of a million of books, would be opened for use on the 16th of June by the Duchess of Albany. (Hear, hear.) The Duke of Westminster, in response, remarked that the exhibition which they had seen naturally brought to mind the interesting subject of technical education, which had now happily attained a position which was creating great interest not only in London but throughout the whole country. The report of the Commissioners on Technical Instruction was very encouraging. After inquiry into the subject in France, Germany, and Switzerland, and other parts of Europe, the Commissioners report that great as had been the progress of foreign countries, keen as was the rivalry with us in many important branches, as a whole the English people were well maintaining their position at the head of the industrial world. Nothing could be more encouraging or satisfactory than that, for it was perfectly true. Further than that, he he had received a letter from Mr. Arnold Morley with reference to the lace trade in Nottingham, and the writer stated that the art school at Nottingham had been of immense advantage, and that the great artistic progress made in the designs and patterns of late years was distinctly traceable to the school training. Speaking generally of the work produced by British workmen, he said that he had himself reason to know how good it was. In the case of his own house—Eaton Hall, which he had been compelled to rebuild—with the exception of Belgian girders, Italian mosaics, and some foreign woodwork, the whole of the work had been done by British workmen, and it was his opinion, and that of others perhaps better qualified to judge, that for solidity and good art-workmanship it could not be surpassed. There was still, however, a great deal to be done in this country in the matter of technical education, and therefore it was that the gift of £20,000 of the Drapers' Company for the building and fitting of the new technical schools was most important. Foreign nations devoted great attention to the instruction of their people from an early age. He therefore coincided with the Commissioners in their recommendation that greater encouragement should be given in the elementary schools to technical education. The children in foreign schools were kept in the schools much longer than the children in this country, and the sacrifice was greater to the parents abroad than to those here. In England children were taken away from school at too early an age, and he thought they should be kept there until they were fourteen. Something more, too, should be done in the matter of secondary schools, and he thought there should be greater encouragement given to the maintenance of secondary schools both for young men and women. He then drew attention to the funds at the disposal of the Charity Commissioners, and said that there was every prospect that that body would out of those funds materially assist the movements in the north and south of London to have People's Palaces somewhat after the excellent example set at the East-end.

ANNOUNCEMENTS.

THE BRITISH ASSOCIATION.—At the 58th annual meeting of this association, which will begin at Bath on Wednesday, September 5, the president will be Sir Frederick J. Bramwell, D.C.L., F.R.S., M.Inst.C.E. The vice-presidents will be the Right. Hon. the Earl of Cork and Orrery, K.P., Lord Lieutenant of Somerset; the Most Noble the Marquis of Bath, the Right. Hon., and Right Rev. the Lord Bishop of Bath and Wells, D.D., Right Rev. the Bishop of Clifton, D.D., the Right Worshipful the Mayor of Bath, the Right Worshipful the Mayor of Bristol, Sir F. A. Abel, C.B., D.C.L., F.R.S., V.P.C.S., the Venerable the Archdeacon of Bath, D.D., the Rev. Leonard Blomefield, M.A., F.L.S., F.G.S., Professor Michael Foster, M.A., M.D., LL.D., Sec.R.S., F.L.S., F.C.S., Mr. W. S. Gore-Langton, J.P., D.L., Mr. H. D. Skrine, J.P., D.L., Mr. E. R. Wodehouse, M.P., Colonel R. P. Laurie, M.P., Mr. Jerome Murch, J.P., D.L. The local secretaries for the meeting will be Mr. W. Pumphrey, Mr. J. L. Stothert, M.Inst.C.E., Mr. B. H. Watts; and the local treasurers, Mr. A. Hammond, Mr. J. Murch, and Mr. John Stone. The officers for the sections will be as follows:—A.—Mathematical and Physical Science.—President, Professor G. F. Fitzgerald, M.A., F.R.S; vice-presidents, Captain Abney, R.E., F.R.S., F.R.A.S., F.C.S., William Esson, M.A., F.R.S., F.R.A.S., F.C.S.; secretaries, R. E. Baynes, M.A. (Recorder), R. T. Glazebrook, M.A., F.R.S., Professor H. Lamb, M.A., F.R.S., W. N. Shaw, M.A. B.—Chemical Science.—President, Professor W. A. Tilden, D.Sc., F.R.S. V.P.C.S.; vice-presidents, Professor Odling, M.B., F.R.S., V.P.C.S., W. H. Perkin, Ph.D., F.R.S., V.P.C.S; secretaries, Professor H. B. Dixon, M.A., F.R.S., F.C.S., H. Forster Morley, M.A., D.Sc., F.C.S. (Recorder), R. E. Moyle, B.A., F.C.S., Dr. W. W. J. Nicol, M.A., F.R.S.E. C.—Geology.—President, Professor W. Boyd Dawkins, M.A., F.R.S., F.G.S., F.S.A.; vice-presidents, W. Whitaker, B.A., F.R.S., F.G.S., Rev. H. H. Winwood, M.A., F.G.S.; secretaries, Professor G. A. Lebour, M.A., F.G.S., W. Topley, F.G.S. (Recorder); W. W. Watts, M.A., F.G.S., H. B. Woodward, F.G.S. D.—Biology.—President, W. T. Thiselton-Dyer, C.M.G., M.A., B.Sc., F.R.S., F.L.S.; vice-presidents, Professor E. A. Schäfer, F.R.S., P. L. Sclater, M.A., Ph.D., F.R.S., F.L.S., F.G.S., F.R.G.S., Sec. Z.S.; secretaries, C. Bailey, F.L.S., F. E. Beddard, M.A., F.Z.S., S. F. Harmer, B.Sc., Walter Heape, M.A. (Recorder), Professor H. Marshall Ward, M.A., F.L.S. E.—Geography.—President, Colonel Sir C. W. Wilson, R.E., K.C.B., K.C.M.G., D.C.L., F.R.S., F.R.G.S.; vice-presidents, the Right Hon. Lord Aberdare, G.C.B., F.R.S., V.P.R.G.S., E. Delmar Morgan, F.R.G.S.; secretaries, J. S. Keltie, F.R.G.S., H. J. Mackinder, M.A., F.R.G.S., E. G. Ravenstein, F.R.G.S. (Recorder). F.—Economic Science and Statistics.—President, the Right Hon. Lord Bramwell, F.R.S., F.S.S.; vice-presidents, J. B. Martin, M.A., F.S.S., R. H. Inglis Palgrave, F.R.S., F.S.S.; secretaries, F. Y. Edgeworth, M.A., F.S.S., T. H. Elliott, F.S.S. (Recorder), Professor Foxwell, M.A., F.S.S., L. L. F. R. Price, B.A., F.S.S. G.—Mechanical Science.—President, W. H. Preece, F.R.S., M. Inst. C.E.; vice-presidents, W. Anderson, M.Inst.C.E., W. Shelford, M.Inst.C.E.; secretaries, C. W. Cooke, W. Bayley Marshall, E. Rigg, M.A. (Recorder). H.—Anthropology.—President, Lieutenant-General Pitt-Rivers, D.C.L., F.R.S., F.G.S., F.S.A.; vice-presidents, J. Beddoe, M.D., F.R.S., J. Evans, D.C.L., LL.D., Treas.R.S., F.S.A., F.L.S., F.G.S.; secretaries, G. W. Bloxam, M.A., F.L.S. (Recorder), J. G. Garson, M.D., F.Z.S., M.A.I. The first general meeting will be held on Wednesday, September 5, at 8 p.m. precisely, when Sir H. E. Roscoe, M.P., D.C.L., LL.D., Ph.D., F.R.S., F.C.S., will resign the chair, and Sir F. J. Bramwell, D.C.L., F.R.S., M.Inst.C.E., president elect, will assume the presidency, and deliver an address. On Thursday evening, September 6, at 8 p.m., a *soirée*; on Friday evening, September 7, at 8.30 p.m., a discourse on "The Electrical Transmission of Power," by Professor W. E. Ayrton, F.R.S.; on Monday evening, September 10, at 8.30 p.m., a discourse on "The Foundation Stones of the Earth's Crust," by Professor T. G. Bonney, D.Sc., LL.D., F.R.S., F.S.A., F.G.S.; on Tuesday evening, September 11, at 8 p.m., a *soirée*; on Wednesday, September 12, the concluding general meeting will be held at 2.30 p.m. Excursions to places of interest in the neighbourhood of Bath will be made on the afternoon of Saturday, September 8, and on Thursday, September 13.

INTERNATIONAL GEOLOGICAL CONGRESS.—The meetings will be held in the rooms of the University of London, Burlington-gardens. The opening meeting will be held on Monday evening, September 17th, when the council will be appointed and the general order of business for the session will be determined. The Congress will last during the whole week, the ordinary meetings beginning at 10 a.m. Among the subjects to be discussed are the Geological map of Europe, the classification of the Cambrian and Silurian rocks and of the tertiary strata, and some points of nomenclature, etc., referring to the Congress, by the International Commission. In addition to these questions, the organising committee proposes to devote a special sitting to a discussion of the crystalline schists. Contributions on the subject are expected from several foreign specialists. An exhibition will be held during the week of the Congress to which geologists are invited to send maps, recent memoirs, rocks, fossils, etc. Excursions of the Congress will take place in the week after the meeting (September 24th to 30th). The number of these will depend upon the number of members desirous of attending, and upon the districts which they most wish to visit. The excursions at present arranged for are:—The Isle of Wight, North Wales, West Yorkshire, and East Yorkshire. Short excursions during the week of the Congress will probably be made to Windsor and Eton, St. Albans, Watford, Brighton, Kew Gardens, and other places of interest. Moreover, everything will be done to accommodate foreign geologists who desire to make excursions to any particular districts. The honorary president of the Congress will be Professor Huxley; the president, Professor Prestwich; the vice-presidents, the Director-General of the Geological Survey, the President of the Geological Society, and Professor McK. Hughes; treasurer, Mr. F. W. Rudler; and general secretaries, Mr. J. W. Hulke and Mr. W. Topley. As honorary members of the organising committee we find the Chancellors of the various Universities, the Lord Mayor, the President of the Royal Society, the Director of the Ordnance Survey, the Hydrographer to the Admiralty, the Directors of the Natural History Museum and of the Royal Gardens, Kew; the Secretary of the Science and Art Department, Sir J. D. Hooker; Sir Richard Owen, Sir A. C. Ramsay, the presidents of the leading scientific societies, and the leading geologists of the country.

DIARY FOR NEXT WEEK.

Monday, June 4.—Victoria Institute, at 8 p.m.—*Annual Meeting.*
Society of Engineers, at 7.30 p.m.—*The Acton Main Drainage Works;* by Mr. C. N. Lailey.
Society of Chemical Industry, at 8 p.m.—*The Mode of Using Char in Sugar-Refining;* by Messrs. B. E. R. and J. A. R. Newlands. *The Adulteration of Olive Oil and Method of Detection;* by Mr. T. Bruce Warren.
Royal Institution, at 5 p.m. — *General Monthly Meeting.*
Bradford Naturalists' Society, at 7.30 p.m.—*Reports of Rambles and Exhibits.*

Tuesday, June 5.—Royal Institution, at 3 p.m. — *Conventions and Conventionality in Art;* by Mr. S. Colvin.
Society of Biblical Archæology, at 8 p.m.—*Les Actes copies du Martyre de St. Polycarpe;* by Professor Amélineau. *Remarks on some Unpublished Cuneiform Syllabaries with respect to Prayers and Incantations Written in Interlinear Form;* by Dr. Bezold. *The Khetta-Hatté and their Allies;* by Rev. C. J. Ball.

Wednesday, June 6.—Entomological Society, at 7 p.m.

Thursday, June 7.—Royal Institution, at 3 p.m.—*The Growth and Sculpture of the Alps;* by Prof. T. G. Bonney.

Friday, June 8.—Royal United Service Institution, at 3 p.m.—*Military Cycling;* by Lieut.-Colonel A. R. Savile.
Royal Institution, at 9 p.m.

Saturday, June 9.—Royal Institution, at 3 p.m.—*Count Tolstoi as Novelist and Thinker;* by Prof. C. E. Turner.
Physical Society, at 3 p.m.—*The Analogy between Gases and Substances in Dilute Solution;* by Prof. J. H. Van't Hoff.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch London.—All letters, Britannia Tool Factory Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new applianes, metal-spinning, milling, etc, in an ordinary lathe; 3s. post free.—BRITANNIA COMPANY, Colchester.

Chisel Steel, 1 to 5 feet bars, ⅝ to 1¼ octagon, 13s. per cwt.—GILBERT, Oxford Road, Sheffield.

Best Cast Steel for tools, taps, and dies, drills, 6d. per lb.—GILBERT, Oxford Road, Sheffield.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Dynamo, 120 candle power, improved armature, 100s. Photo. 5 stamps.—D. WALTON, Hebden Bridge, Yorkshire.

Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps. Castings, lamps, etc.; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s.; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

Meerschaum and Briar Pipes Repaired, Mounted, or cased, ambers fitted.—W. GEORGE, 324, Essex Road, Islington, London.

Fretwork, Carving, Turning, Woods, Tools, and all requisites. Catalogue with 700 illustrations, 6 stamps.—HARGER, BROS., Settle.

Second-hand Lathes, and other tools, offered cheap; on view, Britannia Co., 100, Houndsditch, London.—Send 2 stamps for list, to Britannia Works, Colchester.

5in. Burnishers, 7s. 6d. 1 Silver steel bar, warranted: 6½ in., 12s. 6d.; 9 in., 20s.; 15 in., 40s.—C. C. VEVERS, Horsforth, Leeds.

Photographic Specialities, cheap and good.—Stills, head-rests, backgrounds, washing machines, lamps, shutters, etc. Lists free.—C. C. VEVERS, Horsforth, Leeds.

Patterns.—100 Fretwork, 100 Repoussé, 200 Turning, 300 Stencils, 1s. each.—COLLINS, Summerlays Place, Bath.

Tandem and Cripper Frames, Diamond and Cross-Pattern Safety Frames. Fittings of all kinds at lowest prices.—TRENT CYCLE CO., Nottingham.

Conjuring.—Good stock of apparatus cheap. Bishop's Great Sealed Letter, etc. Funny Ventriloquial Dialogues.—LOCKYEAR, Emsworth.

Tricycle, front steerer, Coventry make, good condition, £5, worth double.—ARMY CONTRACTOR, Granville, Sandgate, Kent.

To Emigrants.—Beautiful double Breech-Loader, splendid condition, 3 guineas, approval.—HILLSDON, Harbour House, Folkestone.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

A Treatise on Heat. With numerous Woodcuts and Diagrams. By Balfour Stewart, LL.D., F.R.S., late Professor of Natural Philosophy at the Owens College, Manchester. Fifth edition. London: Clarendon Press Warehouse. Price 7s. 6d.

Asbestos. Its Production and Use. With some Account of the Asbestos Mines of Canada. By Robert H. Jones. London: Crosby, Lockwood and Co. Price 1s.

An Elementary Text-Book of Practical Metallurgy. By A. R. Gower. London: Chapman and Hall. Price 3s.

A Text-Book on Steam and Steam Engines. For the use of Students Preparing for Competitive Examinations. By A. Jamieson, C.E., F.R.S.E., Prof. of Engineering, Glasgow Technical College. With 200 Illustrations and four plates. London: Charles Griffin and Co. Price 2s. 6d.

Tropical Africa. By Professor Henry Drummond, F.R.S.E. London: Hodder and Stoughton. Price 6s.

First Lessons in Science (Astronomy). By the Right Rev. John William Colenso, D.D., Bishop of Natal, 1853-1883. London: Ridgway. Price 1s.

Metalliferous Minerals and Mining. By D. C. Davies, F.G.S. With 148 Engravings. Fourth edition. London: Crosby, Lockwood and Co. Price 12s. 6d.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, May 21st, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	41·4 degs., being 2·5 degs. below average.	5·1 ins., being 0·4 ins. above average.	323 hrs., being 46 hrs. below average.
England, N.E.	42·4 „ „ 3·0 „ „	5·0 „ „ 0·6 „ „	289 „ „ 9 „ above
England, East	43·2 „ „ 4·1 „ „	4·0 „ „ 0·2 „ „	300 „ „ 104 „ below
Midlands ...	43·4 „ „ 3·5 „ „	4·1 „ „ 0·1 „ below	270 „ „ 87 „ „
England, South	44·0 „ „ 4·1 „ „	5·0 „ „ 0·8 „ above	280 „ „ 100 „ „
Scotland, West	41·9 „ „ 3·0 „ „	7·1 „ „ 0·7 „ „	235 „ „ 21 „ „
England, N.W.	42·2 „ „ 4·1 „ „	3·9 „ „ 0·7 „ below	296 „ „ 60 „ „
Scotland, S.W.	44·0 „ „ 4·1 „ „	5·6 „ „ 0·5 „ „	340 „ „ 77 „ „
Ireland, North	42·9 „ „ 3·7 „ „	5·4 „ „ 0·1 „ above	286 „ „ 80 „ „
Ireland, South	44·8 „ „ 3·2 „ „	6·4 „ „ 0·1 „ „	335 „ „ 68 „ „
The Kingdom...	43·0 „ „ 3·5 „ „	5·2 „ „ 0·16 „ above	295 „ „ 63 „ „

The highest temperature observed during the last week of the period was 80 degs. at Bawtry, being a higher empe rature than any observed since the last week of August, 1887.

Scientific News

FOR GENERAL READERS.

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SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In my last I described the great solar outbursts which form the solar prominences, and hurl metallic and earthy hail (such as iron and oxides of the earth-metals, whose vapours are seen at the base of the prominences) far away from the sun, some to return at once, some to travel in closed orbits, and some probably to go beyond the reclaiming power of the sun, and form comet, and meteorite material for other stellar systems.

I will now discuss the nature and origin of the stupendous force that effects these explosive eruptions. The theory I am about to advance demands one assumption, and one only, and this has a pretty broad basis. The spectroscope indicates vast abundance, predominating proportions, in fact, of hydrogen in the vaporous envelope of the sun, and in its flaming photosphere. Oxygen also is indicated, but, as already stated, the spectroscope is a weak witness, one whose evidence on this point is ambiguous. My one assumption is that Draper and others are right in their interpretation of the solar spectrum, viz., in concluding that the sun's atmosphere includes oxygen.

Now let us see what must happen if this be the case. As we all know, hydrogen and oxygen remain together as a mere mixture while their temperature throughout is low, but if any portion of such mixture is raised to a red heat, chemical combination takes place, and gaseous water is formed, the combination occurring with explosive violence and flaming outburst. This violence attains its maximum when the gases are mixed in the proportion of two volumes of hydrogen to one of oxygen, those required for the formation of water, without any residuum of either remaining after the explosion. The common lecture-table experiment of blowing soap bubbles with such a mixture, and applying a light to them, illustrates this. The explosion is so loud that whenever I have shown this experiment a sense of deafness lasting for a few minutes has followed.

It is evident therefore that if the great atmosphere which we know surrounds the sun were an admixture of these two gases, or such admixture diffused in explosive proportions in other gases, the whole of it would be fired by the heat at its lower part, and our sun would be one of those flashing stars that are occasionally seen to blaze out in the heavens and then subside.

But such is not the case, and therefore the gases named, if there in abundance, must be already combined, *i.e.*, must exist as aqueous vapour. A number of observations that I must not step aside to describe show that such is the case, that the solar atmosphere largely consists of water kept in vapour condition by the solar heat.

We know that this solar heat increases in intensity as we proceed downwards or inwards from the upper or outer regions of his atmosphere towards the flaming orb itself, and we have abundant reasons for concluding that at greater depths below the visible surface of the sun, the heat grows progressively more and more intense, and that the sun itself is gaseous within to vast depths, if not down to its very centre. It may have a solid nucleus, but this must be relatively small, comparable to the stone within a peach.

The evidences of this non-solidity of the sun are numerous. I will select one as an example. Carrington, who worked with dogged industry from November 9th, 1853, to March 24th, 1861, in observing and counting, measuring and mapping the sun spots every day when the sun was visible at Redhill, and recorded his results in a folio volume of 250 pages and 166 plates, discovered, among others, one very important fact, viz., that the sun's rotation on its axis is irregular. The equatorial regions of the sun complete a rotation in shorter time than the polar regions, which could not happen in a solid body without tearing it to pieces, and cannot happen in a liquid or gaseous body without a sort of tearing, *i.e.*, the formation of vortices or whirlpools due to the collision of streams moving in different velocities. Observation proves that the visible surface of the sun is riven into furious tornadoes by hurricanes of inconceivable violence forming whirlpools of such magnitude that into their

yawning depths worlds like ours might be poured like marbles into a teacup. These form the sunspots, some of which, on measurement, have been found to have an area of more than 400 millions of square miles. Their depths remain unmeasured.

Everybody who has watched the eddies in a stream due to irregularities of motion of the water, knows that these eddies whirl downwards, and are surrounded with compensating upheavals of bulging waters. Such is the case with the solar eddies, their surrounding bulge forming the well-known *faculæ*, billows of flame measurable in tens of thousands of miles in length, and thousands in breadth.

But what must happen to aqueous vapour drawn down by these mighty maelstroms into the hotter depths of the sun's interior ?

The researches of Deville, Cailletet, Bunsen, and others prove that it must become *dissociated* by the heat, *i.e.*, again restored to the condition of an explosive mixture of hydrogen and oxygen in their most explosive proportions, and yet they cannot explode, so long as their temperature exceeds a certain point varying with the pressure—about 5,000° Fahr. at our atmospheric pressure, but much higher down in the ardent depths of the sun's interior. Thus they remain in peace below, but when it comes to their turn to be upheaved again as the bulging faculæ, thus rising above the general level of the solar photosphere, which constitutes the outline visible to us, the conditions are changed. Now they are free to radiate and develop the mighty chemical energies residing within them, and they rush together with their characteristic violence, the magnitude of which baffles our feeble imaginations when we endeavour to mentally measure it. If the explosion of a soap-bubble, filled with this mixture of gases, is deafening, what must be that of a quantity amounting to the bulk of a score of our worlds ? I might say a hundred, but that the water-gases are mixed with other gases and metallic vapours which the explosive action of the combining gases flings forth along with the water-vapour formed by their union.

For reasons which I have not space here to expound, these explosions cannot be instantaneous like that of the gases on our lecture-tables, but must be rocket-like, with continuously increasing projective force up to a certain point. The observed phenomena correspond with this theoretical demand.

I also abstain from stating my own theory of the cause of the irregularities of the solar rotation, but merely add that they apply not only to our sun, but equally to all the other suns of the universe, *i.e.*, to the stars, provided they have attendant planets like ours. We have only to suppose the conditions producing our solar prominences to be magnified sufficiently, and we get the outblaze of variable and flashing stars, that have presented such difficult celestial puzzles to our astronomers.

SPONTANEOUS MOVEMENTS OF CERTAIN BODIES ON THE SURFACES OF LIQUIDS.

CAMPHOR, various solid odoriferous bodies, and porous substances saturated with volatile liquids, produce on the surface of water singular movements of rotation and translation. In the earlier half of the century these phenomena attracted much attention in the learned world. They have been ascribed sometimes to electricity, sometimes to the simple mechanical effects of recoil produced by the escape of vapours or fluids emanating from the floating bodies and striking against the air or the water. No definite solution, no clear and satisfactory explanation of the phenomena was given.

Dutrochet, in order to explain the question, assumed the existence of an unknown force, residing in the surface of contact of any two liquors, and named it the "epipolic force." But this notion of a novel force was rejected ; physicists returned, in preference, to an effect of recoil analogous to that of a gun, though every one must have perceived that there was a great disproportion between this cause of motion and the effect produced.

The idea of Dutrochet was not far wrong. At present it is generally recognised that the surface of a liquid is the seat of a force known as *surface tension*. Of this we must endeavour to form a clear notion, as it is essential for an understanding of what has to follow.

Let us suppose a bubble of soap left at the end of the tube which has been used to inflate it. We see its volume rapidly diminish, and, in fact, disappear. The air is driven out as if by an internal pressure. It is demonstrated that the force which produces this pressure resides solely upon the free surfaces of the bubble, whether the inner or the outer. Each surface acts like an extended elastic membrane, which keeps the air under pressure.

But it is not necessary to have a thin film of liquid with *two* free surfaces. From our point of view a drop of water is very similar to a soap-bubble, though it has only one free surface, corresponding to the outer surface of the bubble. We may demonstrate that the free and *plane* surface of any liquid whatever is also the seat of a force which acts exactly as if the liquid mass was bounded by a very thin membrane, elastic and extended. To this force are due the phenomena of capillarity, and possibly others less well known. It may be added that this *surface tension* of liquids is in all likelihood merely a special case of the attraction exerted among all bodies.

But it is very noteworthy that the intensity of this surface tension varies with the nature of the liquid in question. This may be seen on plunging one and the same capillary tube into different liquids, which will ascend to very different levels. To change the surface tension of water it is merely needful to pour upon it a little of some other liquid. The change is almost always a decrease, as the surface tension of water is greater than that of almost all other liquids.

M. Devaux, setting out from these fundamental notions, has described in *La Nature* the little scientific toy represented in Fig. 1. This is a boat cut out in thin tin-foil and sloped away at the stern. If the boat is placed upon water it floats easily. A drop of alcohol is then placed upon the stern by means of a pipette, so as just to touch the water, when the boat at once begins to move. At first sight it seems as if a sudden and powerful repulsion was caused by the contact of the water and the alcohol. But let us consider the facts from the point of view of the tensions and the tractions which the boat undergoes when surrounded on all sides by a liquid surface. At the prow and on the sides this surface is pure water, and is consequently the seat of a strong tension. Behind it is covered with alcohol, and this stratum, though extremely thin, renders the tension decidedly less. Hence, being acted on by two contrary and unequal agencies, the boat

yields to the more powerful, and is continually drawn towards the free surface of the water.

Hence it is unnecessary to assume the existence of a repulsive force of an unknown nature, since we know that there exists an attractive force which cannot remain ineffective, *i.e.*, the difference between a strong attraction, effects. Even vapours show the result, and if air charged with these vapours be drawn into a capillary tube, which is then plunged into water, the level will be lowered in a noticeable manner (Fig. 2). We perceive that the effect is produced by vapours of camphor. Hence we may foresee that this body will set the boat in

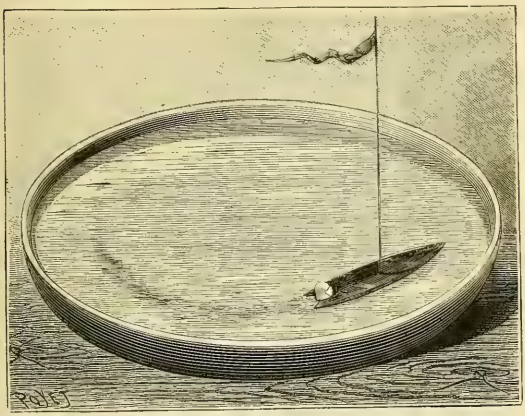


FIG. 1.—TIN BOAT MOVING ON WATER OWING TO ACTION OF A LUMP OF CAMPHOR IN THE STERN.

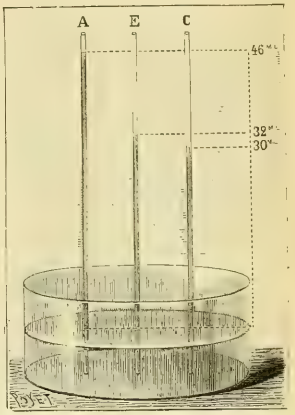


FIG. 2.—LEVELS TO WHICH WATER RISES IN CAPILLARY TUBES FILLED RESPECTIVELY WITH AIR, A, ETHER (E), AND CAMPHOR (C).

FIG. 3.—MOVEMENT OF FINE GRAINS OF CAMPHOR ON THE SURFACE OF MERCURY.

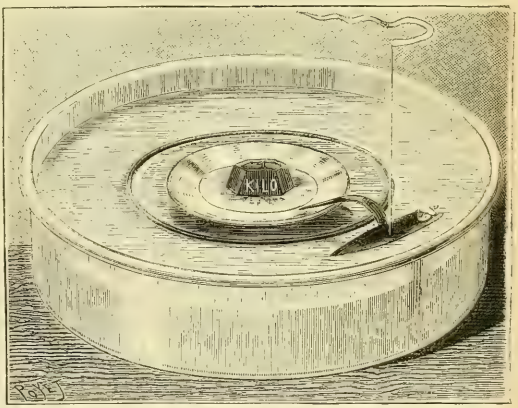


FIG. 4.—TIN BOAT, AS IN FIG. 1, TURNING A HEAVILY-WEIGHTED FLOAT.

that of the water, and a feeble attraction, that of the alcohol. This fact is absolutely general. Ether, chloroform, the essences and the oils all produce a more or less rapid movement of the boat.

It might be expected that these effects would only be produced with a considerable stratum of the liquid superimposed upon the water. But on the contrary, a very slight layer is sufficient to produce considerable motion like the liquids above-mentioned. The boat is not merely set in motion, but it keeps up a rapid and regular movement for hours. This experiment is very easy, and it may be made visible to an audience by fixing a mast (a straw) upright in the boat by means of sealing-wax, a little streamer being attached to the summit.

The result is the same for mercury, upon which cam-

phor moves as it does upon water. It is not necessary for this purpose that the mercury should be purified with extreme care. It may be skimmed from dust, etc., by passing over it once or twice a slip of very clean glass. On sprinkling over it a few granules of camphor, and forming a haze on the surface with the breath, we observe a multitude of objects like long-tailed tadpoles, of extreme agility, moving on the surface of the mercury. Each is formed by a spot, a trace of the vapours in the midst of the haze which leaves the mercury bare. This experiment, which is very easy, is shown in Fig. 3.

It is possible to demonstrate, for mercury as well as for water, that the movement is due to a difference of surface-tension. To prove this experimentally it is merely necessary to blow gently from one side in a continuous manner upon the surface of the mercury. The tadpoles, if we may so call them, flock in the direction contrary to the blast, and collect on the convex margin of the mercury nearest the observer. The movements are more lively if the mercury is slightly warmed. The same thing may be observed with naphthaline.

The experiment can be performed upon water, though the success is not so certain. The material used is burning flower of brimstone, scattered upon the water. It displays there capricious movements analogous to those of camphor. Upon blowing the flame grows more active, and a fragment often moves against a violent current of air up to the edge of the vessel. The observation is here the more striking, as the wind carries along all other floating particles.

We now know the cause of the movements of the camphor, but we know nothing as yet of the mechanism of their stoppage. It appears, however, from the experiments of MM. Joly and Boisgiraud, that this stoppage takes place whenever a fatty pellicle, however slender, exists on the surface of the water.

It seems very natural to attribute the stoppage to a decrease of the surface tension. An analogous experiment is demonstrative of this effect: place upon very pure water a ring formed of flexible thread, waxed. It is irregular in its outline, but if a drop of oil be placed within it, it suddenly changes into a circle which the oil does not pass. If placed outside, the drop of oil produces the opposite effect, the ring contracting into folds as close as the flexibility of the thread permits. These two effects follow from the fact that the wire is in each case drawn towards the surface which is free, and which has consequently retained all its force. This shows that the oil reduces the surface-tension of the water.

But another factor must be considered, *viscosity*. It is so great that we may see the oily layer move as a whole with all that it contains. To separate these two causes of stoppage, viscosity and reduction of surface-tension, M. Devaux has connected, by means of a rigid bridge, two identical boats, one placed upon an oily surface and the other on a surface of pure water. A floating ring of brass wire, varnished, is first placed upon very pure water, and the connection between the two boats is then fixed astride of the ring. A fragment of camphor placed at the stern of the outer boat sets the whole in motion. A drop of oil is then placed in the inner circle and the movement continues, being scarcely slackened. It is observed, however, that from this moment the ring is also manifestly carried along. Thus the viscosity of the oil does not suffice to explain the stoppage of the movements of the camphor. The change of the surface tension is the sole important factor.

As a further refutation of the theory of a reaction, M. Devaux places upon water, whether oily or not, a large float in the form of a watch-glass, and the boat is placed close to its edge (Fig. 4). The movement continues, though of course slackened. Upon the float he places any object, so that the total weight to be moved may reach 50 or 100 grammes, or even a kilo.; the movement continues. If it be stopped it quickly begins to move again.

If we think of the friction overcome and the mass carried round, we must admit that the current produced by the emission of less than 1-50th of a cubic millimeter of vapour per minute is unequal to such effects, for it would be necessary to ascribe to the particles emitted a sudden velocity of 70 kilometres per second.

From these experiments it may be concluded that the cause of the movements of camphor upon mercury is now explained and found to be a known and measurable force.

The question of the action of oil upon the waves of the sea may, perhaps, be usefully taken in hand from this side.

NOTES ON ESSENTIAL OILS.

ANISE oil is now almost wholly produced in Russia.

Camphor oil, from Japan, is coming into favour as a solvent for resins, paraffines, stearin, etc. In Japan it is coming into use as a solvent in lacquers. A favourite lacquer consists of camphor oil, 10 parts; oil of turpentine, $3\frac{1}{2}$ parts; and copal resin, 8 parts. Paper treated with a solution of common resin in camphor oil becomes very transparent. A lacquer for metals is made by mixing camphor oil, 22 parts, with melted asphalt, 5 parts. Paper may be rendered waterproof by treating with a mixture of camphor oil and linseed oil.

Cananga oil, designated as Indian, imported from Java, is supposed to be derived from the same plant as that which furnishes the ylang-ylang oil of the Philippines, but it is sold at a much lower price, and is very inferior in odour.

Cedar-wood oil, used largely in Germany as a basis for soap perfume, is obtained chiefly from the waste of the lead-pencil industry.

Eucalyptus oil, from *E. globulus*, is now produced in California in large quantities as a by-product in the manufacture of a preparation to prevent incrustations in steam boilers. Algeria also competes with Australia in the production of this oil, and is able to supply all present demands. The manufacture of the oil in Australia is, however, increasing, and a plant is about to be established also in Tasmania for distilling it. The statement that the oil of *E. amygdalina* contains no eucalyptol is reaffirmed. The product sold as eucalyptol derived from the last-named species differs *in toto* from true eucalyptol. The former consists of a mixture of a terpene (eucalypten, $C_{10}H_{16}$) with a little cymol, and is distinguished at once by its low specific gravity, 0·886 at 15° C., the genuine article having a sp. gr. of 0·930.

Turkish geranium oil (Palmarosa oil), more properly called Andropogon oil, is said to be submitted to a special treatment to render it suitable for use in adulterating oil of rose. It is bleached in the sun and rectified several times over rose leaves.

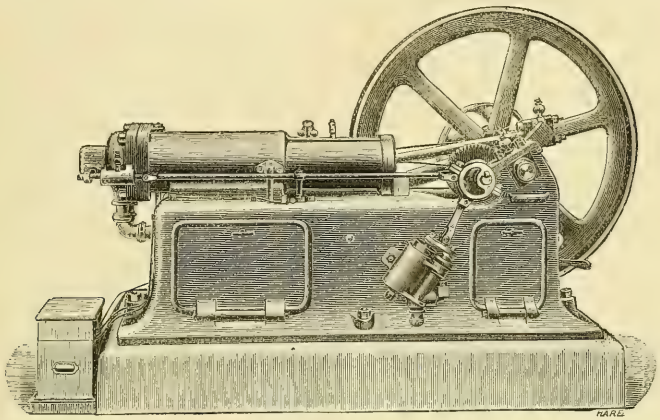
THE PRIESTMAN PETROLEUM ENGINE.

IN gas engines the power is derived from the explosion of successive charges of gas and air in the cylinder, and many attempts have been made to work engines of this type with vapour of petroleum instead of gas. At first sight it would appear comparatively easy to do this, but in reality the difficulties are considerable. In the first place the oil must be vapourised before being admitted to the cylinder, for if it be not in a very fine state of division it will not thoroughly mix with the air required for its combustion. The usual speed of such an engine is about 160 revolutions per minute, and to insure uniformity of power it is necessary to have an explosion every revolution, or at least every alternate one. Seeing, therefore, that at best there is only the eightieth part of a minute in which the gas or vapour can mix with air before the charge is ignited, it is evident that only an attenuated vapour can be used instead of gas. For instance, the ordinary petroleum of commerce, such as is used for lamps, etc., has not hitherto been used, because it does not vapourise readily, and because its vapour so soon condenses. The best results hitherto attained have been with a light petroleum spirit, such as gasoline, having a specific gravity of ·650 to ·670; but in most countries its price is almost prohibitory, and it is seldom used, except for little engines of half or one-horse power. Attempts have been made to use rather heavier oils in the form of fine spray produced by an air injector, but the results have not been very encouraging, and again the cost of the oil is great.

In the Priestman engine (made under the several patents of Priestman, Humes, and Etève) a new feature has been introduced which promises very well. A small pump attached to the engine, and shown on the front of our illustration, forces air into an oil receiver, and causes a very fine jet of oil to enter a little retort, in which the oil is at once vapourised. The oil vapour, mixed with a suitable proportion of air, then enters the cylinder, and is exploded by an electric spark. In this way ordinary petroleum, with a specific gravity of ·800, and with a high flashing point, can be used. This is not only important from an economical point of view, but because the heavier oil can be used without danger, whereas the light oils are so volatile that very special precautions have to be taken.

To start the engine, the retort is first heated by a lamp, and after the engine has been run a short time the retort is heated by the waste products of combustion from the exhaust.

Sir William Thomson and others have tested the engine, and he reports that the quantity of oil used (of gravity about ·800) was at the rate of 1·71 pints, or 1·69 pounds per brake horse power per hour. He also states that this engine does not use the lighter portion of the oil only, but consumes the whole of the oil put into the tank, without leaving a residuum. He adds further that the piston requires no oiling, as the vapour admitted into the cylinder lubricates it sufficiently. All these points are of great importance, and we are very pleased to have so high an authority for them. At the same time it is clear that if 1·69 lb. of oil are required per effective horse power per hour, the working cost of an engine of this type will be much greater than with a good steam-engine, or with a gas-engine driven by Dowson gas requiring only the same weight of coal per horse power per hour. In countries where suitable oil is low in cost, the advantages of the Priestman engine will be more apparent, but in Great Britain or other countries where coal is much cheaper than oil, we fail to see how the latter can be used with economy. The expert's reports give only the brake horse power developed during the trials, and not the indicated power, but it would have been interesting to know the actual power absorbed by the pump and other working parts of the engine. The theoretical dynamic effect of a pound of oil is very great, and if we knew the consumption of oil per indicated horse power per hour, *i.e.*, the gross power actually developed in the cylinder without reference to the friction of the mechanical parts, we could determine the efficiency of the machine as a heat engine.



Apart from questions of strict economy, there are many cases of engine power being required for isolated houses, etc., where there is no gas, and where coals are expensive and difficult to obtain. In such cases, the ease with which the engine and oil apparatus can be worked are doubtless well worth consideration.

EXOTIC VINES.

M. DU DUBOR has communicated to *Cosmos* an account of species, whether of the true genus *Vitis* or of some closely allied forms such as Cissus and Ampelopsis, which may become suitable for cultivation, or which may at any rate serve for stocks to be grafted with scions of *Vitis vinifera*. Our readers will doubtless find some of his facts very interesting.

There exist in China and Japan a number of vines yielding edible fruits. The Chinese have long been acquainted with the production of wine, an art which they have carried to a high degree of perfection. It appears, however, that upon the vines there exists an insect which has an industrial value, so that vineyards are kept up for the production of these parasites. In a Japanese work, translated by Count Castillon, we read:—

"The best are those coming from Taka-ga Mine, in the province of Yamasiro. The vine which produces them has branches, leaves, flowers, and fruits quite similar to those of the Budo (cultivated vine). Its shoots come out in the spring, and bear, three months after, clusters of small yellowish flowers. The fruit is ripe in August and September. The berries are small, round, and of a light violet. The shoots present at intervals swellings in which are found certain white larvæ, which are used as a remedy for the convulsions of little children." In China the fruits are fermented for the production of wine, "and yield the so-called Bi-Syu, or sweet wine of the poets."

Certain young plants of vines have been brought from Japan, and their cultivation has been attempted in France, but without any decided success. The species tried have been the Yama Bouto, from the mountains of Japan and the Kochu, a variety of the common vine which vegetates very freely.

Some Chinese vines may not improbably give rise to useful varieties. These are *Vitis Romaneti*, *Vitis pagnucci*, and *Spinovitis Davidi*.

Their discovery is due to a learned Lazarist missionary, Father Armand David, who has sent their seeds to M. Romanet du Caillaud.

Spinovitis Davidi, a thorny species, has been discovered in a valley at the altitude of nearly 11,000 feet. *Vitis Romaneti* is found 100 miles farther to the south on a purely granitic soil at the altitude of 4,000 feet. Both these species have to bear very severe winters.

Plants of both these species are already growing in Dordogne, and are very precocious. In the vineyards of M. Romanet they have already yielded fruit. The grapes of *Vitis chaisi*, in China, have a very delicate flavour. *Vitis amurensis* grows in the country of the Amour, and has black, sourish fruits.

What is the future of these vines as regards resistance to the phylloxera? Time alone can decide.

In Cochin China there are vines with tuberous roots and annual stems which in the forests attach themselves to the trunks and branches of trees, and climb to a great height. A single plant sometimes yields two cwt. of grapes. The clusters often weigh eight or nine pounds.

The attempt has been made in Cochin China to prepare wine from these grapes, but it is scarcely drinkable, and contains very little alcohol. These tubers have grown in France and yielded fruit, but their wine will not enter into consumption until the plants have been ameliorated by cultivation. The climate of France is possibly not warm enough, but they might very probably succeed well in Natal or Queensland. They are, it may be safely said, absolutely proof against the phylloxera.

The vines of Kashmir may be of greater interest to European cultivators. A certain M. Ermens, employed over the gardens of the Maharaja, reports that three species of vines grow in the forests, rising to the summits of the loftiest trees. The natives distinguish three species, which they name opiman, kavaury, and katcheboury. M. Ermens has collected the fruits of these species, and has made wine. Opiman yielded a red wine of an agreeable flavour, somewhat resembling the Rhenish wines. Katcheboury is a fine and good white grape, and gave a white wine, resembling Chablis. Kavaury yielded merely vinegar, which, however, is not to be despised.

Cabul produces also vines of great luxuriance. Captain Hetcher, of the English army, states that they yield enormous clusters of white or yellowish grapes, having the flavour of the chasselas. They abound in the milder valleys of Afghanistan and along the Himalaya. They might not improbably succeed in Europe.

Among African species we must not forget the famous tuberous vines of the Soudan. They have had their day of celebrity in France, for the narrative of the traveller Lecart instilled hope into the hearts of vine-growers. Now, it is no longer looked upon as a possible source of grapes or of wine.

The Arabian vine, which grows in the North of Africa, has long been known to the natives. One variety, named Hasseroum, gives a wine which is almost black, and which is highly alcoholic, and has a clean flavour. These vines, in the wild state, yield about 3 cwt. of grapes per root. A proprietor in the Vaucluse possesses some of these vines, which have resisted the phylloxera for some years.

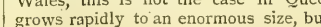
The Cape yields also tuberous vines. One of them transplanted into France by M. Mazel bore fruit for the first time in 1886, but the grape, of a blackish violet colour, has an acid pulp, which is not a favourable sign.

In Guinea and in other parts of Africa there are also numerous species of *Cissus*, *Ampelopsis*, and even of *Vitis*, but their capabilities have not yet been ascertained.

Of the American vines we know too much. If certain French cultivators had not taken the uncalled-for step of introducing them into Europe, we should have heard nothing of the phylloxera.

As for Australasia we have little to say. Botanists and travellers mention several vines as growing in those regions. Thus in the Isle of Timor there is a *Vitis vinifera*, yielding fine clusters of a delicious perfume. But the land of the Orchids does not seem to be the quarter to which the vine-dresser may turn his eyes in hope. The best proof is that the Australians introduce and propagate in their country the old varieties admired by our forefathers.

It may be mentioned that though the common vine succeeds to perfection in South Australia and New South Wales, this is not the case in Queensland. Here it grows rapidly to an enormous size, but yields no fruit.



It appears from *La Liberté* that the National School of Astronomy has been suppressed by the French Government, and that the Observatory is kept in want of the necessary funds.

General Notes.

Production of Betose.—It is said that the yearly production of beetroot sugar in France is 600,000 tons, whilst in Germany it exceeds a million.

Proposed South Polar Expedition.—According to the *National Zeitung*, Mr. Henry Villard is planning a German South Polar Expedition. It is said that the project is very favourably entertained in influential quarters, and that there are good prospects of its being carried into effect.

Large Hailstones.—Professor Grant, of Glasgow, reports that hailstones as large as pigeons' eggs fell in the storm which raged over Scotland on May 20th. This is corroborated by a gentleman at Grangemouth, who had the curiosity to measure and weigh one stone, which was $\frac{3}{4}$oz. in weight, and $1\frac{1}{2}$ inch in diameter.

Solomon Islands.—We learn from *Nature* that Mr. C. M. Woodford, the successful naturalist explorer of the Solomon Islands, is about to leave England on a third visit to the group. After spending some time in various parts of the islands not previously visited, he will investigate Santa Cruz, Woodlark Island, and other islands lying to the south-east of New Guinea.

Discovery of a New Star.—On the nights of the 8th and 9th ult., the Rev. T. E. Espin, of the Wolsingham Observatory, noticed a star of the eighth magnitude in the constellation Cygnus which, not being registered in the 'Durchmusterung,' is presumably new. Its colour is red, and the spectrum was found to be not continuous. The approximate place is R.A. 20 hrs. 42 mins., N.P.D. 45° 29'.

Transparent Platinum.—According to the *English Mechanic*, when a mixture of platinic chloride and glycerine is evaporated to dryness in a glass dish, a perfectly transparent deposit of metallic platinum is obtained; the light transmitted through this is of a dark greyish-blue tint. In this respect, therefore, platinum shows close analogy to gold, which, as is well known, in thin leaf transmits green light.

Tunnelling a Volcano.—We learn from the *English Mechanic* that a scheme is under consideration in Mexico for tunnelling the volcano of Popocatapetl through the wall of the crater, in order to reach the immense sulphur deposits inside the mountain. A narrow-gauge railway will connect the tunnel with the town of Amecameca, which, in turn, will connect with the Morelos road leading to the national capital.

Electric Lighting at the South Kensington Museum.—In his annual report to the Science and Art Department of the Privy Council, General Festing states that the working expenses of the electric light at South Kensington Museum amounted to £1,224. If gas had been used the cost would have been £2,845. It would be interesting to hear more of this matter, for if the figures be correct electric lighting must be cheaper than gas—and that remains to be proved.

Marinated Mackerel.—At a recent show of the Cornwall Polytechnic Institution, Mr. Perry, of Penzance, exhibited some jars of marinated pilchards, which, after twelve months' keeping, were found perfectly good. The same process is now successfully applied to mackerel. The principle is the exclusion of air by means of a layer of paraffin wax or ozokerite, which is poured in melted, so as to close the top of the jar. A writer in the *Field* preserves honey in the same manner, and the method might doubtless be extended to the more delicate fruits.

Under-sea Explorations.—Some members of the Liverpool Geological Society spent the Whitsuntide holiday in dredging off the coast of the Isle of Man. Their object was to discover a deep-sea channel supposed to exist near the Manx coast. The *Liverpool Courier*, which gives an account of the expedition, says that in pre-glacial times when land extended over much of what is now the Irish Sea, a prolongation of the valley of the Mersey probably ran in a north-westerly direction for some distance, but is now buried under the drift deposits.

Scientific Research Fund.—Amongst the grants recently made by the Committee of this fund are £100 to Professor Piazzi Smyth, for spectroscopic work; £40 to Professor Tait, for work in natural philosophy; £25 to Messrs. Hebertson and Rankine, on behalf of the Ben Nevis Observatory, for apparatus for photographing clouds and optical phenomena at Ben Nevis; £100 to Mr. Joseph Thomson, for exploration and the collection of objects of natural history in Morocco; £100 to Mr. Hoyle, of the *Challenger* Office, for systematic report on Cephalopoda; £40 to Mr. R. Kidston, for an inquiry into the distribution of the fossil fauna in the British carboniferous rocks; and £100 to Mr. J. Rattray, for investigation of the diatomaceæ.

Deep-sea Exploration.—On May 25 a party of scientists, consisting of Dr. Ball (Astronomer Royal), the Rev. W. S. Green, Mr. Joseph Wright, F.R.G.S., Mr. Lloyd Praess, C.E., Mr. R. Day, Mr. W. D. K. Kane, and Mr. T. H. Poole, C.E., left Queenstown in the powerful tug, *Flying Falcon*, on a six days' exploring expedition, under a grant from the Royal Irish Academy, to the south and south-west coasts of Ireland, for the purpose of discovering the several species of fishes and animals in different depths of the ocean to the depth of one thousand fathoms. The scientists were provided with a complete dredging apparatus. The rarer species of animals, when brought to the surface, will be photographed by Mr. Day, and carefully preserved for distribution between specialists in England and Ireland.

A New Zealand Sulphur Island.—According to Mr. R. W. E. Macivor, White Island, in the Bay of Plenty, New Zealand, is part of the crater of a huge, submerged conical volcano. Part of the island disappeared during the volcanic disturbance in New Zealand a year or two ago. The mineralogical and other characteristics of the place in 1883 were such as are common in volcanic regions, but a noticeable feature were some curious hollow spheres, consisting of an exterior crust of gypsum and a little sulphur, with transparent sulphur crystals inside. In the midst of the central plateau is a lake,

Lake Hope, muddy and unfathomable in the centre, but transparent and fairly uniform in depth elsewhere; the atmosphere over it, owing to the constant evolution of hydrochloric acid gas, was very irritating.

Geological Discovery at Aberdeen.—In preparing the foundations for the piers of the Schoolhill Viaduct, the workmen encountered at a depth of from six to seven feet, a bed of red earth, soft at the top but increasing in hardness as they proceeded downwards. On examination, this has turned out to be a well-marked stratum of old Red Sandstone conglomerate. The rock is of the usual deep red colour, and the embedded boulders are Of a granitic nature, consisting chiefly of quartzite, gneiss, and granite. When the beds were first examined it was considered likely that they might be part of the Old Red Sandstone beds that extend along the coast from Stonehaven to the Tay, but a closer scrutiny of the boulders has shown that they are of a much more granitic character than those found in the measures further south, and that the deposit is of a purely local kind, beginning, it is believed, immediately north of the Dee, in the vicinity of the Joint Station, and ending in boldly marked beds of conglomerate on the south bank of the Don, not far from the Brig of Balgownie.

Ancient Monuments.—An Order in Council was published on May 30th, dated May 3rd, 1888, ordering and prescribing that certain monuments shall be deemed to be ancient monuments within the meaning of the Act of 1882. Section 10 of that Act provides that her Majesty may, by Order in Council, declare that any monument of a like character to the monuments described in the schedule to the Act shall be deemed to be an ancient monument. The monuments now declared to be ancient are:—(1) The Nine Stones, Winterbourne Abbas, near Dorchester; (2) the Chambered Long Barrow, known as the Gray Mare and Colts, near Gorwell, in the county of Dorset; (3) the Stone Circle on Tenant-hill, Kingston Russell Farm, near Dorchester; (4) the Cup-marked Rock at Drumtroddan Farm, Mochrum; (5) the Three Standing Stones, Mochrum; (6) the Moat-hill, of Druchtag, Mochrum; (7) the semi-circular earthwork on the sea cliff, Barsalloch, Mochrum; and (8) the ancient chapel at the Isle of Whithorn. These last five monuments are in the county of Wigtown. The Order will not come into force until it has lain for forty days before both Houses of Parliament during the Session.

Remarkable Phosphorescent Storm.—The Anchor Liner *Anchoria*, in her last trip from New York, passed when about 350 miles east of the American coast, near the borders of the Gulf Stream, through phenomena which, although frequent on a small scale, are extremely rare in such grandeur as that which was observed on this occasion. After the vessel had been running over twenty-four hours in a dense fog, the water around the vessel suddenly became so luminous that a long shoal of small fish darting around the vessel, seeking refuge from sharks and other enemies, gave the sea in the immediate vicinity of the vessel the appearance of a vast cauldron of boiling jewels. The furrows of foam from the ship's bows rolled in such brilliant masses of violet light as to render the smallest thread in the ship's rigging clearly visible. The engines had to be slowed for a few hours until a storm of wind, bursting from the north-west cleared off the fog and broke the whole visible surface of the ocean into an infinity of flying crests of flame-like foam of such brilliancy that the ocean seemed ablaze with fleeting, flashing flame. The whole horizon line had the appearance of an immense belt of light-blue fire. This beautiful display lasted from 11 p.m. till 3.30 a.m.

Interesting Discoveries in America.—While making a survey for a proposed railway through the old Spanish presidio of Janos, situated in the wild Sierra Madre of Mexico, a succession of dwellings stretching for miles along a cañon were discovered. The houses are built in terrace form, one above the other, with solid masonry, unlike the crude cliff buildings of Arizona and New Mexico. These dwellings had more the appearance of regular streets, being built above each other on the shelving declivity of the cañon, and being difficult of access, as if for purposes of defence against powerful enemies. Most of the buildings have their front walls constructed of hewn stones, carefully cemented, while the rear portions are built into the sides of the cañon. All of these ruins are in a remarkable state of preservation; so much so that they deserve, it is said, more the name of abandoned dwellings than of ruins. On an open plain rear the ruins are the remains of an aqueduct and a terraced reservoir. Mr. Cushing, the Zuni explorer, has also uncovered a buried city for a distance of three miles. It was evidently destroyed by some mighty upheaval of nature ages ago. There are miles of irrigating canals, streets, and houses; while here and there in the ruins of the latter, as in Pompeii, is the skeleton of a hapless inmate whose escape was cut off. The city is within 200 miles of the Gulf of California, off a branch of the Southern Pacific Railroad.

The Electric Light in the Suez Canal.—The number of ships navigating the Suez Canal at night with the electric light shows a rapid increase since the new regulations came into force on the 1st March last year. Consul Burrell, of Port Said, gives the following table showing the number of vessels with the electric light passing through the canal in each month last year:—

January	13
February	12
March	15
April	19
May	19
June	25
July	27
August	35
September	45
October	49
November	63
December	73
Total	395

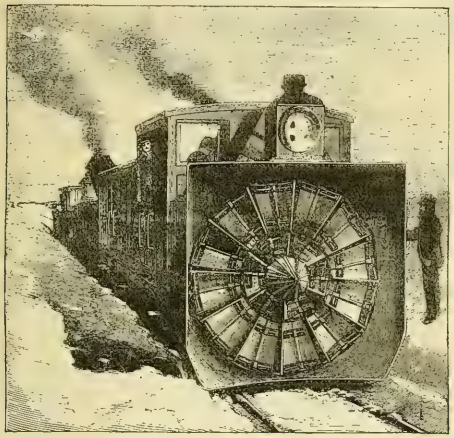
The average time of the transit of the canal in 1887 is given as 33 hrs. 58 mins. as compared with 36 hrs. in 1886. The shortest time taken by an ordinary steamer with the electric light for night navigation was 15 hrs. 5 mins. A still faster passage was made by Mr. Gordon Bennett's steam yacht *Namouna*, which, being allowed to steam at greater speed than larger vessels, only took 13 hrs. and 53 mins. from Port Said to Suez.

A ROTARY STEAM SNOW SHOVEL.

IN a recent number of the *Scientific American* an account is given of the various snow ploughs used on railways in the United States. The most common of the old methods was a plough attached to the front of a heavy locomotive, the latter itself being pushed by other locomotives. With all the power it was possible to apply in this way, however, the progress was slow, failures were frequent, and the plough and locomotives often had to be dug out by gangs of labourers. Many engines have also been wrecked, and lives have been lost by attempting to ram a way through snow which had been packed in a cutting.

Where the snow is sufficiently packed and frozen, a method has been adopted of cutting out blocks the width of the railway, and these blocks are hauled away by a locomotive to a point where they can be conveniently deposited out of the way.

According to our contemporary, by far the most satisfactory method of accomplishing this work is with the rotary steam snow shovel, a good idea of which will be gathered from our illustration.



From this it will be seen that in front of the machine there is a large wheel carrying knives, and as this is rotated it cuts the snow and throws it away. This wheel is mounted on the outer end of a longitudinal steel shaft, connected by means of bevel gearing to a cross shaft, actuated by a pair of horizontal steam cylinders.

The direction in which the snow is thrown may be changed from one side of the track to the other, as it would evidently be inexpedient to force the snow in a direction against the wind, and there are many places where it would be better to direct it one way rather than another.

The boiler has more heating surface and the fire-box is larger than is usual on locomotives. The whole machine with engine and boiler is mounted on an eight-wheeled car, under the charge of a pilot who can by signals communicate with the engineers on the rotary and the pushing engines, and by a hand-wheel he can also alter the position of the hood that directs the stream of snow to either side.

There are also devices for cleaning the rails as effectually as by hand with picks, shovels, and brushes. The machine has a weight of some fifty tons, and is pushed into the snow by one or two locomotives, as may be required. The capabilities of the machine will be better appreciated, perhaps, by reading the following report recently published in the Minneapolis *Tribune*:

"One of the rotaries started out in Dakota in the middle of January, after the terrible storm, while the thermometer was still 30 degrees below zero. Sidings covered with from 1 to 3 feet of snow were first cleared, the rotary being pushed by one engine. The next operation was to open the northern division from Jamestown to Minneawaukon. The first obstacle encountered was a cutting filled with 12 feet of solid snow, packed, and frozen hard for about 25 feet, while for 100 feet more the drift varied in depth from 1 to 5 feet. The rotary was pushed by two engines, but stalled after penetrating 5 feet into the deep cutting. On backing out it was found that the face of the drift on which the rotary cutters had been working resembled polished granite in shine and consistency. The sides of the face were then shovelled down, and the rotary, after repeated attacks, worked through the obstruction. As many as nine ordinary snow ploughs had been smashed up in trying to open the same cutting in the previous spring, but within three hours the cutting was opened, and another one 500 feet long and varying from 2 to 8 feet deep had also been cleared, and an abandoned and buried train had been disinterred. The train was taken back to Jamestown, and the rotary started again next morning, making an advance of 46 miles during the day. Two cuttings 600 and 800 feet long respectively, blocked with snow from 2 to 8 feet deep, were cleared out. In the deepest parts the snow was packed solid and frozen hard. But, notwithstanding this, the worst cutting was opened in 50 minutes. It is found that where the snow is not hard packed—of the consistency where an ox can walk on it without sinking in more than 2 inches—the rotary will clear out snow 10 to 12 feet deep, while moving two or three miles an hour."

The working of the machine is described as being a remarkable sight. The centrifugal force of the wheel is so great that the snow is discharged in the form of a great stream or cloud, and hurled to a distance of from 100 to 300 feet from the track.

THE ROYAL OBSERVATORY.

THE Astronomer-Royal, in his report to the Board of Visitors on Saturday the 2nd inst., said the extension of the computing rooms, referred to last year, has been carried out, and the whole of the staff of the astronomical department are located in two rooms, with means of ready communication between them. On the top of the extended rooms a dome 18 ft. in diameter (covered with papier-mâché) has been erected, in which it is intended to mount an equatoreal and photoheliograph.

The subject of railways in proximity to the Observatory was once more brought into prominence by a proposal to construct a tunnel under Blackheath in connection with the Bexley-heath Railway. On five nights observations were made to test the effect of the trains on the South-Eastern line on a special class of observation (the image

of the wires of the transit instrument, as seen by reflection from a trough of mercury). The result showed that tremor from trains in the tunnel between Blackheath and Charlton (about a mile distant) caused the image to disappear; and as the proposed tunnel was to pass within 570 yards of the instrument, the Government opposed the Bill, and the Blackheath route was abandoned.

With one or more of the equatoreals, twenty-four occultations of stars by the moon double the average of the preceding seventeen years, eighteen phenomena of Jupiter's satellites, and three comets (on twelve nights) have been observed In common with many directors of observatories, the Astronomer-Royal has to lament the fact that clouds almost set at naught his elaborate arrangements (with nine instruments) for securing observations of the small stars occulted during the lunar eclipse of January 28th last.

The Sheepshanks equatoreal has been devoted to experiments in stellar photography, to determine the extent of field available on curved and plane plates. The experiments show that the advantage derived from the use of curved plates is very doubtful, and that the images on plane plates are good enough as far as two degrees from the centre.

With the spectroscope attached to the $12\frac{3}{4}$ in. equatoreal, 333 measures have been made to determine the rate of recession or approach, in the line of sight, of sixteen stars; and certain stars have been observed for Mr. Lockyer.

Photographs of the sun were obtained on 205 days of the 356 ending May 10th. For the year 1887, supplementing the Greenwich series by photographs taken in India and the Mauritius, a record of the sun's surface has been secured on 361 days. The reduction of the measures of these photographs is complete, and the results ready for the press.

In the magnetic department the continuous registration of the changes of magnetic declination, horizontal force, and vertical force has been maintained, a duplicate set of photographs being taken since January last, so that one set may be available for persons wishing to discuss Greenwich records. Five measures of resistance of the earth-current wires gave very discordant results; in fact, these wires have not yet recovered the effects of the snowstorm of December, 1886, and it seems hopeless to attempt to express the measures of ordinates on the photographs in terms of the electrical units, until the conditions of the circuits have been improved. It is thought that a slight dislocation in the trace soon after sunset, and a sudden return to original position just before sunrise, which increase the difficulties above referred to, are connected with the electric lights in the vicinity of the earth plate at Angerstein's wharf. It may be remarked here that the Observatory is dependent on the courtesy of the South-Eastern Railway Company for carrying the earth-wires.

The meteorological records for the year 1887 show that the mean temperature was 47·8 degrees, or 1·5 degree below the average of the preceding 46 years. The highest temperature was 92·2 degrees on July 4th, and the lowest 15·5 degrees, on January 2nd. The number of hours of bright sunshine was 1,401, or 190 above the average of the preceding ten years. The rainfall was 19·9 inches, being 4·8 inches below the average of the preceding 46 years.

The Greenwhich time-ball was dropped regularly except on four days of very high wind; the Deal ball except on eight days, on six of which the telegraphic connexions were interrupted. Automatic signals have been received to check the errors of the Westminster clock and that used to drop a time-ball at Devonport. The error of the former was less than 1 sec. on 25 per cent. of the days of observation, and amounted to 4 secs. on only 2 per cent.

The report concludes with the following remarks by Mr. Christie, which excited much comment among the visitors :—

"In my last report it was suggested that the instrumental equipment of the Observatory should be supplemented by a photographic refractor of thirteen inches aperture (equatoreally mounted) to enable Greenwich, as the National Observatory, to take its share in the scheme for forming a photographic map of the heavens, and for thus extending our knowledge of the places of the fixed stars. Consequent on the resolution of the Board of Visitors at the last visitation I brought this question of the insufficiency of our instruments for the present wants of astronomy to the notice of the Admiralty and of the Chancellor of the Exchequer, and the matter is still under the consideration of the Government. If the Royal Observatory is to take part in this work of carrying out one of the principal objects for which the Astronomer Royal was appointed, it appears to be essential that a decision should be arrived at without delay, in view of the circumstance that thirteen observatories (including those of Melbourne and Sydney in our own colonies) have already ordered their instruments, which are to be completed by the end of the present year.

"Allusion was made in the last report to the increased demands made on the Observatory in recent years both by the scientific and the general public, and in view of the consequent development of work it now becomes necessary to review the position of the establishment, which was constituted many years ago, when the conditions were very different. In order to understand the difficulty of the present situation it is necessary to bear in mind the following facts:—In 1835 there were five assistants (excluding the chief assistant) having no computers to superintend, no extraneous work beyond the care of a relatively small number of chronometers for the navy, no magnetic and meteorological observations, no altazimuth observations, no spectroscopic and photographic observations. At the present time there are eight assistants (excluding the chief assistant) having fifteen computers to superintend, and of this staff two assistants are absorbed by the magnetic and meteorological branch, one by the altazimuth, and two by the spectroscopic and photographic branch, leaving only three assistants to do the astronomical work, which in 1835 required five assistants, and in addition to perform all the extraneous duties which the Astronomer Royal has felt it desirable to undertake in the public interest.

"Under these circumstances it becomes a matter for serious consideration whether, unless adequate provision be made for the primary objects of the Observatory, extraneous work, such as the supply of time-signals, may not have to be dropped. The service of hourly time-signals throws considerable work on myself and the staff of the Observatory, and, as it is purely voluntary, it appears to me that a condition of its maintenance must be that arrangements shall be made to enable the proper work of the Observatory to be carried on and suitably developed."

Natural History.

THE SAND GROUSE OF TARTARY.

Broadly speaking we may divide migrating animals into two great classes, not marked off, of course, by any very hard and fast outlines. There are species, exclusively birds, which pass regularly from tropical to temperate, or from temperate to arctic climates, returning to their original quarters at the close of the season. Examples of such migrants are the swallows and the nightingale, which visit us in summer, and the wild goose and the fieldfare, which herald the approach of winter.

The Sand Grouse (Syrrhaptes paradoxus).

The second class of migrants, much less regular in their movements, include not merely birds but mammals and insects. Such creatures travel in directions not necessarily relating to latitude, but, as it appears to us, at random, often from east to west. Their expeditions are not undertaken annually, nor at any regular interval. They may remain for years stationary, in what we must call their home, and then all at once they may be found undertaking a distant journey. A further characteristic of these irregular migrants is that they are neither known to return whence they came, like the swallows, nor to become naturalised in any of the countries which they visit. Often indeed they may stay and breed, occurring year by year in reduced numbers, and at last disappearing altogether until a fresh immigration takes place.

Of such irregular visitants there are instances many. Naturalists have often speculated on the movements of the Norwegian lemming (*Myodes lemmus*). At intervals which may be as much as ten or fifteen years, these little rodents make their appearance in the inhabited and cultivated parts of Norway, moving straight to the west. When they reach the ocean they plunge in and swim for the Lofoten Islands, which very few only reach, the majority perishing in the stormy West Fjord.

The irruptions of the true Eastern locust (*Oedipoda migratoria*) are well known. Occasionally this destructive insect enters Europe in force, and commits serious damage in South Russia, Hungary, and even in Germany and France. But in these latter countries, much less in Britain, it has never succeeded in establishing itself in permanence.

In 1877 English entomologists were excited by the appearance in great numbers of the "Clouded Yellow" butterfly (*Colias edusa*) generally considered a rarity. We remember seeing these insects even in Trafalgar Square, in Cavendish Square, and on the Holborn Viaduct; and near Dartford we overheard a collector boasting that he had taken "ten dozen specimens that day." But in a year or two these gay visitants dwindled down to their usual rank as rarities.

We cannot, of course, further enumerate the occasional migratory movements of animals, or speak of the clouds of butterflies and other insects which have been seen far out at sea, moving away from the nearest land. But we may cast a glance at the possible causes of such wanderings.

The most obvious is the quest for food. If a species has multiplied beyond the capabilities of its normal

home, or if a hard and protracted winter has reduced the supply of food, emigration becomes a matter of necessity.

It is also suggested that the wandering species may have been, in the remote past, regular annual migrants which have gradually settled down and become stationary, yet now and then revert to their ancestral habit.

Very general attention has been drawn this year to the appearance in considerable numbers of *Syrrhaptes paradoxus*, a bird inhabiting the steppes of Central Asia. It is generally known as the "Tartary Sand Grouse," as Pallas's Sand Grouse (from its discoverer), or as the "Partridge of the Steppes." Of this stranger more than a hundred specimens have been seen in Britain this season, whilst in Central Europe it has been plentiful, from Pomerania to Dalmatia.

Strictly speaking this bird, of which we subjoin an illustration, is not a grouse at all, but a partridge. It is rather smaller than our common partridge. Its colour is for the most part an impure yellow, passing into a light bay. The head, throat, and the region of the eyes are orange-coloured, the breast grey, and the belly black. The wings are of a dark-brown, and the back is striped transversely with black. It has only three toes; the feathers on the feet, which come down to the toes, resemble hair. The middle tail-feathers and the tips of the wings are long and pointed. It is swift on the wing, and is therefore not especially debarred from a migratory life. In China its cry of "truck-turuck, truck-turuck," is often heard in the valley of the Hoang Ho.

We must not suppose that the steppe-partridge is this year making its first appearance in Europe. It was discovered by Pallas, to the west of the Caspian in 1773. The first specimen seen in Europe was in 1848. In July 1859, one was killed near Norwich, and a few others were seen. In 1863 they entered Europe in thousands, spreading from Archangel to Albania, and as far westwards as the coast of Donegal. A single bird was found at Plauen, in Saxony, in June 1864, perhaps a survivor of the flocks of the previous year. In 1872 a few were seen in Northumberland and in Ayrshire. In 1876 a single specimen occurred at Modena in Italy.

Since that time none have been recognised in Europe until the present season. They appeared about the end of April in various parts of Germany, Austria and Hungary, and have since spread on to England.

Here, the headquarters at once of humanitarianism and of the wanton destruction of animal life, they will fare badly. The "Wild Birds Protection Act" is simply a dead letter which no one cares for or dares to put in force. For the benefit of the exterminators we may say that the sand-grouse, or steppe-partridge, is but indifferent eating. We must remember that rare birds have to dread, not merely the gamekeer and the "rough," but the pseudo-naturalist, who is always eager to secure a "British specimen" of any bird or insect.

Milk and Butter Trees.—The rich and little-known vegetation of Upper Senegal and Upper Niger includes curious forest specimens, whose fruit or sap furnish men with food products analogous to milk and butter. In the first place, we may mention a sort of oak called the karité. This tree bears fruit somewhat like that of the horse chestnut tree, and having a white and compact flesh. These nuts, dried in a furnace and then decorticated, are crushed and powdered, and the resulting pasty flour is put into cold water. This forms a white substance of buttery aspect, which rises to the surface of the liquid, and which, beaten and pressed, constitutes a sort of butter which the natives use as a food. Commander Gallieni, who has studied this substance and its production *in situ*, considers it very nourishing, and thinks that it might also be used for making soaps and candles analogous to those manufactured from paraffin. In Venezuela, the karité has a vegetable competitor in a tree of another species, the tubayba. In this case, it is the abundant lacteous sap of the tree that is utilised. This is collected by the natives by simply making an incision in the bark. According to explorers, the milk of this tree is fatty, has an agreeable odour, and is nutritive. Perhaps the most remarkable of these milk trees is found in the forests of British Guiana. The pith and bark of this tree contain so large a quantity of sap that the least incision made in the surface causes the valuable liquid to flow. The natives hold it in high esteem as a food. This product, called hya-hya, not only resembles milk in appearance, but also in unctuousness and taste.—*Scientific American.*

The Food of Bee Larvæ.—Dr. Adolf von Planta (*Zeitschrift für Physiolog. Chemie*) shows that the food prepared by the bees for the larvæ respectively of queens, drones, and workers, is regularly distinct in its character.

Occurrence of Fluorine in Animal Matter.—According to G. Tammann (*Zeitschrift für Physiolog. Chemie*) fluorine occurs not only, as previously ascertained, in bones, in the brain, and in peas and barley, but in hen's eggs. Here the shell contains a mere trace of fluorine, the white a little more, and the yolk decidedly more. From this gradual concentration we may suspect that fluorine plays an important physiological part in organisms. Fluorine is also found in the milk and blood of cows.

A New Weather Prophet.—At the Jubilee Flower Show at Vienna there was exhibited a mimosa, which is said to foretell, or to enable its owner to foretell, storms and earthquakes forty-eight hours in advance. The sensitiveness of certain plants to light is, of course, well known, and they may, for anything we dare assert to the contrary, react to atmospheric conditions of which we know nothing. But we must beg to reserve judgment on this wonderful plant until its indications have been systematically studied.

Zoometrical Appliances.—M. G. Demeny (*Comptes Rendus*) has constructed instruments for the accurate determination of the external form of the thorax, the extent of the respiratory movements, the profiles and sections of the trunk, and the volume of air inhaled and exhaled.

The Buzzard.—Some discussion has occurred in a contemporary as to the diet of this bird. We quite agree that it is not to be regarded with hostility by game preservers, and we wish to point out that it is useful as a destroyer of vipers. These snakes are on the increase in some parts of England, owing to the war waged by gamekeepers against their chief enemy, the hedgehog.

Cultivation of Sponges in the Adriatic.—Professor Oscar Schmidt, of the University of Gratz, has, according to *Cosmos*, instituted a series of experiments calculated

to give rise to a new branch of industry. He tears up living sponges and plants the pieces in suitable parts of the sea. Very small fragments, if thus treated, yield in a term of three years splendid sponges. The cost of thus producing 4,000 sponges has been only 225 francs, including interest on capital. The Austrian Government has decided to encourage the attempts made on the coasts of Dalmatia.

PRESENCE OF MALIC ACID IN THE "SWEAT" OF HERBIVOROUS ANIMALS.—MM. A. and P. Buisine (*Comptes Rendus*) have discovered malic acid in the suint-water which is obtained in abundance in the industrial washing of raw wools. This discovery is an additional instance of the fundamental unity of the vegetable and the animal kingdoms.

RESUSCITATION OF DISEASE GERMS. — M. Bouchard (*Comptes Rendus*) calls the attention of sanitarians to the unpleasant fact that microbia, which are supposed to have been killed by some antiseptic, may revive completely if they are brought under different conditions. It is therefore necessary to observe if the action of an antiseptic is permanent or merely transitory.

SALMON OVA FOR TASMANIA.—According to the *Tasmanian Daily Telegraph*, Sir Thomas Brady arrived in that colony on April 19th, bringing with him 400,000 salmon ova in good condition. They were preserved in cases in an ice-house, specially built for their accommodation to prevent premature hatching in the tropics. Some larger fish perished whilst traversing those regions, but Sir T. Brady considers that had they been placed in their native Irish water, instead of London water, he could have brought them over in safety.

A WHALE AGROUND.—A large whale, which was basking in the sunshine on the water's surface, was washed ashore on Sherkin Island, near Cape Clear, on May 31st. The tide was ebbing, and the creature was stranded high and dry.

A CORMORANT IN ST. JAMES'S PARK.—A fine cormorant, in breeding plumage—white patches on cheek and thigh—arrived in St. James's Park on May 30th. He was first noticed by the keeper at half-past 8, and was tame and hungry enough to accept from him a couple of herrings for breakfast. At 2 o'clock he was sitting within a few yards of the path which runs along the south bank of the ornamental water, half-way between the bridge and the India Office, and did not seem at all disturbed by the passers-by.

DREDGING EXPEDITION OF THE LIVERPOOL BIOLOGICAL SOCIETY.

ON the 19th ult. a party, consisting of a number of investigators from different parts of the country, including Professors Miall and Denny, of Leeds; G. H. Hurst, of Owens College, Manchester; Arnold T. Watson, of Sheffield; A. O. Walker, of Chester; Herdman, of Liverpool University College, and others, left Liverpool in the *Hyæna* on a dredging expedition.

The only object of interest brought up on that day was a very large specimen of the well-known *Alcyonium digitatum*, or "Dead Men's Fingers," a spongy-looking shapeless mass, which clings to the rocks at Hilbre Island, and on nearly all rocky shores. It is anything but pretty when out of water, but when seen under water, with all the delicate polypes expanded, it is an object of great beauty, and the idea of a "dead man's finger" is entirely forgotten. The mass of this strange, spongy-looking animal which was brought up on Saturday was clinging to a living oyster, and it filled a good-sized aquarium by itself. This was the largest *Alcyonium* ever gathered in the neighbourhood, and its size and the beauty of its polypes excited universal admiration. The workers with the tow-nets were fairly successful, and for some hours they were busy sorting out the minute forms of life which frequent the surface of the sea.

Among the objects thus fished up by the tow-nets were some minute larval forms, which, though neither new nor showy, are to be reckoned among those natural wonders whose interest no familiarity can lessen. There were placed under the microscope, for example, an *Ophiura plutens* and the zœa of a crab. What do these unfamiliar names signify, it may be asked, to the reader who is not a naturalist by vocation? Well, it may be worth notice that the immature Brittle-star and Crab are utterly unlike their parents. The young crab, to take the more familiar case, has a long tail, a great spine upon its back, and soft limbs, very unlike the powerful claws of the adult crab. It is easy to understand that the conditions of life are very different in the soft and transparent larva which swims upon the top of the sea, and the big, heavy, hard-shelled crab; and that very different implements and organs are required by the young and old animals. The zœa finds it useful to bear a spine which may stick in the throat of any carnivorous thing which seeks to make a meal of him. A heavy shell would be an impossible encumbrance to the free swimming larva. But behind these obvious special adaptations lies a general question of some interest. How is it that these startling transformations are so common among the inhabitants of the sea, so rare among freshwater and terrestrial animals? It would shock the general reader to affirm (what is nevertheless quite true), that conspicuous metamorphosis is unknown among land and fresh water animals. We should be met at once with such cases as the tadpole and the caterpillar, and it would take half a column to show that these so-called larvæ are not true larvæ at all. They represent, with considerable modification no doubt, the primitive adult amphibian or insect; and the land-traversing frog, like the winged imago, is really produced by a peculiar adult transformation, exceptionally produced for special purposes, attending the deposit of eggs. But this is a hard point to explain, and we must be content with an ex-cathedra assertion that development with conspicuous change is the rule among marine forms, especially those of small size, and the rare exceptions among land and freshwater animals. Why this difference? A little reflection suggests that the number of the offspring and the size of the egg are concerned. The marine animal produces very many tiny eggs, almost or altogether without yolk, while the freshwater, and especially the land animal, produces a relatively small number of large eggs. Nourished by the abundant yolk, the fortunate embryo can in these cases complete its development in a leisurely way while still within the egg-shell; but the marine youngster belongs to so large a family that the parent turns him out whilst still very small and

tender to shift for himself and find his own food. Hatched out thus early, the young and tender larvæ must develop temporary swimming organs and means of protection which are quite useless to the adult. The first necessity with them is to disperse, and they are provided with simple but effective locomotive organs, which they discard afterwards when they give up vagrant habits and begin to feed in earnest. But there is no end to a good natural history problem. So, having attempted to show that metamorphosis depends upon the number of embryos and the poor provision for their support, we must next consider why a marine animal brings forth a family of such uncommon numbers. The answer is that it has so many enemies, and that vast numbers are needed to meet the losses due to the voracity of the countless predatory forms which people the sea. Fresh waters have their pirates too, but the sea is far more thickly sown with dangers. Lest the reader's patience should be altogether worn out, we will stop explaining, and make no attempt to justify or discuss this last statement.

About eleven o'clock on Sunday forenoon the steamer left Douglas for Port Erin, and the work done on that day was sufficient to make up for a bad week, instead of a bad day. The first cast of the dredge was made between Port Soderick and Port St. Mary in about 18 fathoms of water, where a fierce tide was running. When the dredge came up it was full to the top with dead and living shells of *Pectunculus* and all kinds of univalves and bivalves, dead and alive, and a great mass of beautiful *Melobesia*, thatl ittle understood calcareous, coral-like seaweed. This particular bed of the lime-plant was of a wonderfully rich colour, and the organic parts of the plant were almost invisible to the naked eye, even when a fracture was made, so that it looked like a perfect little tree coral. Besides this, there were countless forms of life, many of them exceedingly interesting in their appearance and their movements. The hermit crabs were plentiful in their shell-houses, and many kinds of star-fish and Echini also came up. The common star-fish (*Asterias rubens*) appeared to flourish in the same spot, for some of the specimens were quite 18 inches across. The ascidians were very plentiful, especially the odd-looking *Botrylloides rubrum*, and the polyzoans were very abundant. A few casts of the dredge in the quiet water under the lee of the Calf brought up, amongst other things, rare star-fishes, like *Cribella rosea*, *Porania pulvillus*, and *Luidia fragillissima*. The real results of the expedition will only be seen some months after this; but the superficial results of the one day's dredging were simply astonishing.

Between nine and ten o'clock Captain Young got all the electric lamps ready, and the great white glare on deck surprised the quiet dwellers in the Port, who knew not what manner of men had come to visit them on a Sunday night. When the party was all assembled, an incandescent lamp was fastened inside a fine muslin tow-net, and lowered down into the clear waters of the bay. At a depth of five fathoms the pale white light presented a most singular appearance, and illuminated the bottom in a very ghostly manner. Another tow-net and another lamp were lowered on the opposite side, but kept near the surface, so as to see what difference there would be between the living things on top and those at the bottom. The effect of the white gleam of electric lighthouses on sea birds is well known, for the birds fly to their death against the tall sea towers; but the effect on fish is not so well known as it should be. The salmon fishers in Highland rivers use the torch to attract the fish, which are then speared; and it is found that sea fish are also attracted by a flame, but they will not bite at a hook, being dazed by the illumination. There is a large probability that the electric light could be profitably used for net fishing, and there is room for careful investigation on this point, in connection with the ever-pressing question of the "harvest of the sea."

The results on Sunday night were surprising. The surface net was found to be rich with small creatures known as Copepods, along with the tiny larvæ of different fishes, while the deep-water net was swarming with Amphipods, almost as large as house flies or ordinary beetles. These small relatives of the shrimp and the lobster are intensely interesting to the microscopist, and the electric light brought multitudes of them to the tow nets. The gorgeous little crystalline speck (*Anomalocera patersoni*) was in great abundance, as were the white-bodied, scarlet-eyed Ampelisca, and the more aberrant Cumacea.

Reviews.

Report of Observations of Injurious Insects and Common Farm Pests, during the year 1887, *with Methods of Prevention and Remedy*. Eleventh Report. By Eleanor A. Ormerod, F.R. Met. Soc., F.E.S., etc. London: Simpkin, Marshall and Co.

Miss Ormerod, the consulting entomologist to the Royal Agricultural Society, is well known as a zealous and accurate student of the life-histories and modes of action of our insect pests. In the report before us she communicates the results of the past year, some of which are decidedly satisfactory, as proving that a close examination of these minute enemies is the only way for their repression. The season of 1887, with its unusual atmospheric dryness, and with its hot days, generally followed by chilly nights, seems to have been favourable to various kinds of pests.

One very interesting case is that of "clover sickness,' caused by the minute eelworm (*Tylenchus devastatrix*). This tiny vermin attacks not merely clover, but oats, onions, etc. If cattle are fed on clover thus infected, the *Tylenchi* passing unhurt through their digestive organs may thus reappear in any crop dressed with their manure.

The Hessian fly (*Cecidomyia destructor*) was first distinctly recognised in Britain in 1886, and it extended last year over a considerable tract, both in England and Scotland, and has done considerable damage to barley, but less to wheat. They have been favoured by the dry weather, and it may be hoped that they will not multiply rapidly if we have our usual amount of rain-fall.

An unfortunate circumstance is that most of the *puparia* (the cases in which the insect undergoes its final transformation) are placed so low in the stems of the grain that they remain in the field after reaping. But if the Hessian fly is undoubtedly present in our midst, it has come attended by its enemies—certain minute four-winged flies—which prey on its larva or pupa.

Miss Ormerod proposes that the screenings from infected grain after threshing should be burnt, and that the stubble left on the field should be burnt also. It is also advisable to sow the wheat as late as possible, so that there may be nothing for the flies to lay their eggs on.

The Ribbon-footed Corn-fly (*Chlorops taeniopus*) is no

new comer in Britain, and effected much more damage last year than the Hessian fly. Unlike the latter, it begins in the ear and works downwards.

A variety of other insects are discussed which injure corn, hops, fruit-trees, etc.; but we must press on to the so-called "warbles." Certain flies deposit their ova on living cattle and horses. The maggots, as soon as hatched, bore down through the hide into the flesh, and occasion great tumours, which may bring on mortification and prove fatal. The damage done in this manner exceeds the belief of outsiders, but practical men estimate the total loss to the country at from two to seven millions sterling, according to the season. Certain animals, as we have already mentioned, perish outright; many more are impoverished and deteriorated, so that they fetch less money in the market, and the hides are often rendered worthless to the tanner as being full of holes. It is noteworthy that the butcher and the tanner have recognised the mischief done sooner than the farmer, who can hardly, in some places, be brought to lay aside the old superstition that they are "healthy." In some districts they are even spoken of as "thriving bumps." But wherever farmers have been induced to take the very simple and inexpensive means recommended by Miss Ormerod, they are quickly convinced of their old mistake. Dairymen find the yield of milk improved, both in quantity and quality, whilst fat stock often fetch from ten shillings to a pound per head more than if they had been infested with this blemish.

For some of the insect pests no remedy has yet been devised, but here, where the means of prevention—or cure—are at hand, farmers will only have themselves to thank if they still go on bearing the loss.

As an instance of a superstition of a totally opposite nature, where an innocent insect is accused of occasioning damage, we may quote the fact that the caterpillar of the beautiful "Elephant Hawk Moth" (*Choerocampa elpenor*) is in some parts of Ireland supposed to give cattle the disease called murrain. In fact this insect is in all stages of its life perfectly harmless. It feeds on weeds—willow-herb and bed-straw—and has no power to injure cattle.

A subsidiary benefit which may result from Miss Ormerod's reports is that few persons after perusing them can any longer profess to regard entomology as a frivolous study.

Forms of Animal Life. By the late George Rolleston, M.D., F.R.S. Second edition, revised and enlarged by W. H. Jackson, M.A. Oxford: Clarendon Press. 1888.

In the preface to the first edition of this work Professor Rolleston points out that "The distinctive character of the book consists in its attempting so to combine the concrete facts of zootomy with the outlines of systematic classification as to enable the student to put them for himself into their natural relations of foundation and superstructure. The foundation may be made wider, and the superstructure may have its outlines not only filled up, but even considerably altered by subsequent and more extensive labours; but the mutual relations of the one as foundation of the other as superstructure, which this book particularly aims at illustrating, must always remain the same."

Now after an interval of eighteen years we have a new edition of the work, and the many points of difference between it and the original may be pointed to as fulfilling what the author had predicted. It is impossible to enumerate even the most important and significant of the advances in comparative anatomy since the first appearance of the "Forms of Animal Life." We may fairly take as evidence of the vast growth of this science the fact that "scientific periodicals, on the general subject and its branches, have since 1870 been almost doubled, not only in number, but also in bulk." Most striking, and wider in its effects than any other work stands that of Professor Balfour, who collected the scattered facts of embryology already known, and added to them by his own masterly investigations to such an extent that we may safely attribute to him in a very large degree the scientific character of the basis upon which comparative anatomy now stands. The effects of the stimulus given by Professor Balfour to anatomical research are notable in his own University of Cambridge, where Sedgwick, Caldwell, Bateson and others have accomplished much good work.

The enormous mass of material which has accumulated in consequence of the activity of such workers in the subject must have made the task of compressing it into the limits of one volume an arduous one; although not only is the size of each page increased, but the number of pages of the old edition is more than doubled in the new. Professor Rolleston took in hand this new edition about two years before his death, but in that time he had by no means finished it. What he left undone—apparently the greater part of the re-writing—has been ably completed by his former pupil and demonstrator, Mr. Jackson. The author's wishes have been carefully observed; they were (1) to enlarge the descriptions of the preparations and accounts of the various classes of animals, and bring them to the standard of contemporary knowledge; (2) to add to each class or group a brief classification; and (3) to give as full a bibliography as space would permit. The thorough manner in which the last has been carried out adds very great value to the book. Still we miss the human and personal interest of the "general considerations suggested by a survey of the subjects treated of" which found a place in the original work, and was evidence of Professor Rolleston's characteristic tendency to become pleasantly discursive, and to introduce "details more curious than important." For instance, he discussed in a foot-note—as perhaps no other man would have done—the relative values of "the many metaphors which have been used to express the general or picturesque effect produced on the mind by a study of a system of biological classification;" and this in order to show the great difference between the works of nature and of man, since, as he said, only those metaphors "retain a strong hold on the imagination which are borrowed from natural objects."

He had also some observations on the subject of Darwin's theory of evolution, which may be quoted as sounding strange in our ears to-day, "The acceptance or rejection of the general theory will depend, as does the acceptance or rejection of other views supported merely by probable evidence, upon the particular constitution of each individual mind to which it is presented. . . . . The value of the . . . hypothetical genealogical pedigrees, reaching far out of modern periods, is likely to remain in the very highest degree arbitrary and problematical."

A serious fault in the old edition, the total want of figures and diagrams to illustrate the descriptions of preparations, has been partly rectified in the new. Thirteen woodcuts have been introduced, but this number is still inadequate to the amount of closely condensed reading

of 258 pages. The plates, though increased from twelve to fourteen in number, do not wholly supply the want.

In its original form this work was a manual such as students might use for their own reading while attending a course of lectures and demonstrations. In its latest development it takes rather the place of a book of reference, being a vast and much condensed collection of facts, thoroughly well selected and arranged. It will be used chiefly by those who are already advanced in the study of comparative anatomy—one of the most fascinating among sciences.

A Manual of Practical Assaying. By John Mitchell, F.C.S. Edited by William Crookes, F.R.S., Pres. C.S. Sixth Edition. Longmans, Green and Co.

Regarded as a standard work, Mitchell's book is very disappointing, and we had hoped to find in the new edition, containing as it does nearly one hundred fresh pages, that revision which it so much requires. Comparatively little, however, has been done. There is still lacking that personal guidance in the choice of one out of many processes given, which characterised the older work; and the processes themselves are described too often in the words of their original authors, somewhat discursively, and conveying the impression that the manual is a collection of newspaper cuttings, rather than a text-book from the pen of a master. Instances of inaccuracies, and obsolete methods, or terms, are too numerous to mention in full, but we may quote a few by way of example. In the very beginning we find misleading explanations of the laws of chemical combination, as when 16 parts of oxygen are said to combine with 1 of hydrogen, or with 207 of lead. On page 154 is given a method of estimating the absolute heating power of a coal, "by ascertaining how much the temperature of a room increases by burning a certain weight of fuel in a stove," but the way in which this experiment is to be carried out is not described. Three pages are devoted to Berthier's method of determining the calorific power of fuels by the reduction of litharge, and no hint is given of its absolute unreliability. In the brief description of Wright's (Thompson's) Calorimeter, it is stated that by burning 20 grs. of coal (instead of 30 grs.) under 290·1 grs. of water (instead of 29,010) in an apparatus weighing 6,642·7 grs., a direct reading of evaporative power is obtained; the instrument is moreover credited with giving very accurate results, while no description of the Favre and Silbermann or other really accurate calorimeters is attempted. The use of Mohr's pinch-cock burette is condemned for use with potassium permanganate solution, but no mention is made of glass-tapped burettes. Twice on p. 526 we find NO_5 for N_2O_5. Throughout the work the wasteful habit of breaking the crucible, to extract the button of metal after an assay, is recommended, rather than the equally satisfactory and more expeditious plan of pouring the fluid contents of the crucible into an ingot mould. In regard to the added matter, we are glad to find that much stress is laid on the necessity for accurate sampling, whether of ore or of ingot. Slight additions are made to the chapter on the blow-pipe, while that on iron and steel analysis is practically re-written; and Blair's elaborate and somewhat costly scheme for the analysis of iron ores is given in full detail, together with Peter's account of the Lake Superior fire assay of copper ores. Of the remaining additions, the accounts of the treatment of gold and silver-bearing copper ores, and the greater part of that dealing with the influence of bismuth on the ductility of silver, are doubtless of the greatest interest from a metallurgical point of view, but have little or no bearing on the subject of the book. In fine, if Mr. Crookes would for the next edition undertake the Herculean labour of condensing, systematising, and re-writing the accumulated items of six editions, a volume of half the size and ten times the value would doubtless result, and he would earn the lasting gratitude of all who now feel the want of a reliable guide to practical assaying.

Journal of the Royal Agricultural Society of England. Annual Report for 1887 of the Consulting Botanist. By W. Carruthers, F.R.S., P.L.S.

The author shows that the seeds obtained by farmers from seed merchants are still to a great extent bad. A sample of white clover is mentioned as containing 10 per cent. of weeds; a sample of cocksfoot contained 34 per cent. of other and worthless seeds, and two samples of rye-grass contained respectively 12 or 15 per cent. of a worthless grass known as "Yorkshire fog," which cattle never eat if they can find anything else. These impurities seem, however, in most cases to be traceable to carelessness rather than to wilful admixture. One sample of meadow-fescue contained the serious proportion of 20 per cent. of rye-grass.

In seeds perfectly free from admixture, whether accidental or intentional, there was also a low standard of germinating power. Of some of the seeds met with in the market, only such proportions as 36, 20, 12, 15, 16, and in one case 6 per cent. have been found to germinate. Such seeds were probably too old, or had been gathered in bad condition. In good samples, on the contrary, as many as 96 and 98 per cent. have been found to grow. We have heard tell of a fraud which is not mentioned here, and which possibly may have fallen into disuse. That is, seeds intended for adulteration were killed by heat before being added to the qualities to be sophisticated.

Some of the samples were ergotised; the spread of this poisonous parasite, dangerous to man and beast, is greatly to be deprecated.

Journal of the Royal Agricultural Society of England. Annual Report for 1887 of the Consulting Chemist. By Dr. J. A. Voelcker, B.Sc.

The author's attention has been to a very great extent turned to the examination of oil-cakes, both the feeding and the manurial qualities. He concludes that it is impossible, from analytical results alone, to decide on the purity of a linseed cake. In all doubtful cases a special microscopical examination is necessary. The proportions of sand and of woody fibre may be as high in a genuine linseed cake as in one containing 30 per cent. of foreign matter. The chief adulterants met with are rape, cockle-seed, mill-sweepings, locust-bean, and hemp-seed.

Dr. Voelcker has also analysed a number of samples of sewage sludge. If we may judge from the figures quoted, we cannot wonder at the low estimation in which such manures are commonly held. All of them have evidently been prepared by some lime process, and in the one where the lime is lowest the sand in compensation reaches 34·01 per cent.

Experiments with basic cinder have been made near Woburn, but owing to the unusually dry weather the results have been unsatisfactory.

Abstracts of Papers, Lectures, etc.

ROYAL INSTITUTION.

THE Friday evening discourse on the 25th ult. was delivered by Mr. Francis Galton, who lectured on personal identification and description. He said he greatly felt the inadequacy of language to express from, when he was dealing with hereditary likenesses, with grouping human features into classes, and with many other topics. The present lecture was the result of the considerable pains that he had taken to overcome this difficulty. There proved to be many alternative ways of doing it, but as he had not yet satisfied himself as to the best, he would avoid details, and confine himself to general remarks. It was perfectly possible to define and to measure resemblance, taking the least discernible difference as the unit for each degree of unlikeness. This simple principle could be easily applied to outlines such as those of silhouettes. It was better at first to go even further in the direction of simplicity, and to consider only that part of the outline of the face which lay between the brow and the parting of the lips. The least discernible difference between two silhouettes might be taken as equal to the one-hundredth part of an inch. Though an exceedingly large number of profiles might be drawn that differed by this small amount in some part of their outline, the number that differed by ten times that amount would be comparatively very small. We might aim at producing a collection of standard portraits, drawn with coarse outlines of one-tenth of an inch in width and then reduced to a small scale, to serve as standards of reference. No profile that fell wholly within the two edges of the coarse outline could differ from its centre by more than five grades of unlikeness. This would be a useful and a first degree of approximation; it would not be a likeness in any other sense than that of excluding the very large proportion of profiles that were still more unlike than those that fell within the specified limits. A mechanical apparatus, described further on, afforded the means of rapidly finding the standard or standards to which any given profile conformed. Individuals differed in a measurable manner in so many respects that a person might be identified with considerable precision by a statement of his measures. The lecturer explained the measurements that were most useful for this purpose, and how registers of them could most easily be searched in order to find whether those of a particular person were contained in them or not. Differences that might be measured, or otherwise clearly defined, existed on a small as well as on a large scale. The curious variety of imprints made by the inked fingertips admitted of being classed and catalogued. They seemed to be singularly persistent, judging from four specimens that were exhibited of the digit marks of Sir W. Herschel, made in the years 1860, 1874, 1885, and 1888 respectively. Though there was a difference of twenty-eight years between the dates of the first and the last, no difference could be perceived between the impressions. The forms of the spirlas remained the same, not only in general character, but in minute and measurable details, as in the distance from the centre of the spiral and in the direction at which each new ridge took its rise. Sir W. Herschel had made great use of digit marks for purposes of legal attestation among natives of India. Prisoners were now identified in France by measurements of their heads and limbs according to the ingenious method of M. Alphonse Bertillon. The measures of each prisoner were all entered on the same cards, and the cards were classified according to the successive measures they contained, just as words were arranged in a dictionary, according to their successive letters. The classification did not take more note of the measures than by placing each in the category of large, medium, or small, as the case might be. Thus one measurement gave rise to three possible groups, two to nine, three to twenty-seven, and so on. The lecturer exhibited the rough working model of an apparatus he had contrived that could select by a single movement those cards out of many hundreds whose measures corresponded within any desired limit with those of any given person. It was free from the objections inherent in all methods of hard-and-fast classification, such as that of M. Bertillon, and could act on a large scale, and with great rapidity and simplicity. The apparatus consisted of a large number of strips of card, or of metal, pivotted through one of their ends by a common axis, while their other ends rested on a frame that turned about the same axis. When the frame was raised all the cards were lifted by it, when it was lowered the cards dropped each independently of the rest by its own weight. The lower edge of each card was variously notched to indicate the measures of the person to whom it referred. The key that made the selection was a board some 30 in. of clear length, with wires stretched lengthways and supported by several bridges. The positions of the wires were adjusted by the same scale as that by which the notches were cut, and the wires were set to represent the measures of the given person. When the board was set crossways under the cards, and these were allowed to fall, they were all checked in their descent by the wires, except those few whose notches corresponded with them. The notches were made wide enough not only to admit the wires but also to allow for some inaccuracy of measurement and misfit. A key of the above length would test 500 cards at once, and might be used in quick succession with any number of sets of cards. The profile of a face, he continued, could be measured with as much precision on the sharp outline of a photograph. The observed differences in feature were severally small, but they were numerous and more independent of one another than the lengths of the various limbs. The best base from which to measure horizontally seemed to be the tangent line that touched the convexity of the chin, and the concavity between the brow and the nose. When the chin was bearded, the position of the concavity must be guessed. A good unit of horizontal scale was given by the distance between the line just mentioned and one drawn parallel to it that just touched the nose. It was better to keep the unit of vertical scale separate, and to use for it the distance between the pupil of the eye and the parting of the lips, measured parallel to the above lines. One of the objects the lecturer had in view in the present inquiry was to discover measurable and independent peculiarities that would assist in hereditary investigations. He had some hope that by noting many of these it might be possible to trace in every person clear evidence of his parentage and near kinship.

ROYAL SOCIETY OF EDINBURGH.

ON May 21st Dr. Archibald Geikie read a paper on "The History of Volcanic Action During Tertiary Time in the

British Islands." He said that the area within which volcanic action manifested itself during the tertiary period in this country was not absolutely and regularly definable, but it went from northern Yorkshire right across to the west of Donegal, and from the northern part of the Lews, down the west of Scotland to the centre, and from the Minch right away down to the south of Antrim. They could divide this history into episodes, and the most tremendous volcanic action was that which produced the basic dykes. Altogether, they had a line of volcanic material somewhere about 180 miles in length, showing itself in this form. All through the dyke region they found two remarkable types of protrusion—the single or solitary series, and the gregarious. The first type of dykes ran through all kinds of rocks, sometimes rising to the surface, and maintained a wonderful parallelism right across the country from sea to sea. They were not so thoroughly basic as those of the second type. He mentioned a block of basalt on the coast of Mull as an example. The second type of dykes was by no means so persistent; they were not so broad or so long, nor so regular or parallel, as the first. Sometimes they were separated by many miles from their neighbours, but sometimes they were crowded all together in a single mass. If they examined them they could be divided into at least two groups. There were those that ran from south-east to north-west. They began at the Cleveland dyke, and went northwards to the Grampians. These dykes all belonged to one period, as might be seen from their uniformity, from the way in which they radiated from one common centre, and from the way in which they cut into the formations with which they were associated. The second group crowded together in districts, and were found in the basin of the Clyde, in Islay, Jura, Mull, and Skye. The great problem that presented itself was what had been the history of these dykes, and how they had come to be where they were. He attributed their existence to the action of the lava, which forced itself up underneath the region of the dykes. The ground was thus arched over, and a horizontal tension cracked the whole country. The lava then solidified and formed the great parallel dykes. But that was only the beginning of a very long, complicated, and interesting series of processes. Dr. Geikie divided the area into four plateaus, pointing out the characteristics of each, and stated that from the evidence they had they were driven to suppose that there was not one central vent in each of the plateaus, but many vents. Dr. Geikie concluded by giving an indication of the composition of the materials of these dykes.

GEOLOGICAL SOCIETY.

At the meeting held on May 23rd, Mr. W. T. Blandford, LL.D., F.R.S., President, in the Chair, the following communications were read :—

"On the Spheroid-bearing Granite of Mullaghderg. Co. Donegal." By Frederick H. Hatch, Ph.D., F.G.S. Communicated with the permission of the Director-General of the Geological Survey.

This paper deals with a remarkable variety of granite which may be compared with the well-known orbicular diorite or Napoleonite of Corsica. According to Mr. J. R. Kilroe, of the Geological Survey of Ireland, who first discovered this interesting rock, the concretionary balls occur in close juxtaposition in a mass of granite of five or six cubic yards in size. They have not been found in any other portion of the granite area.

The author first gave a detailed description of the microscopic structure of the normal granite. It is a coarse-grained rock, composed essentially of quartz, orthoclase, microcline, oligoclase, greenish hornblende, and black mica. Sphene is an accessory constituent. Since it contains no white mica, the rock belongs to that subdivision of granite which has been termed *granitite*. A description of the spheroidal bodies was then given. The balls are somewhat flattened, the greatest diameter being in one case four inches, the smallest three. Each ball consists of two distinct parts, a pinkish central portion (the *nucleus*) and a dark-coloured peripheral or zonal portion (the *shell*). The nucleus consists of an irregular granitic aggregate of oligoclase felspar with a little interstitial quartz. The peripheral shell is composed chiefly of oligoclase, but also contains abundant included plates of biotite, and over 12 per cent. of magnetic iron-ore. It is to the presence of the last-mentioned mineral that the zonal portion owes its dark colour.

The conclusion the author arrived at from a consideration of the subject was, that concretionary bodies occurring in granite, may, according to the mode of arrangement of their constituents, be divided into three classes, viz :—

1. The *concretionary* patches of Phillips.
2. The *granospherites* of Vogelsang.
3. The *belonospherites* of Vogelsang.

The Spheroids from Mullaghderg belong to the last-mentioned class. They must be regarded as concretions formed during the consolidation of the granite magma, by a process of zonal and radial crystallisation around an earlier-formed nucleus.

"On the Skeleton of a Sauropterygian from the Oxford Clay, near Bedford." By R. Lydekker, Esq., B.A., F.G.S.

A description was given of a considerable portion of the skeleton of a Sauropterygian from the Oxford Clay of Kempston, consisting of several upper teeth, most of the mandible (of which the symphysial region is entire), a considerable number of vertebræ mainly from the "pectoral" and dorsal regions, the greater portion of the two pelvic, and fragments of the pectoral limbs, and a considerable proportion of the pectoral and pelvic girdles. These remains were referred to *Plesiosaurus philarchus*, Seeley, and the various parts described in detail.

The author discussed the advisability of retaining the forms described by various generic names by Professor Seeley, under the name of *Plesiosaurus*, and stated his intention of employing the latter term in its widest sense for the present. With this definition, the form under consideration was shown to present characters intermediate between those of *Plesiosaurus* and *Pliosaurus*, but was retained provisionally in the former genus. Although a direct link in the chain connecting the two genera, *P. philarchus* was not regarded as an ancestor of *Pliosaurus*, since teeth undistinguishable from those of the latter genus occur in the Coralline Oolite.

Finally it was concluded that the evidence brought forward was sufficient to render necessary the abolition of the name Pliosauridæ, and the inclusion of *Plesiosaurus* and *Pliosaurus* in a single family.

"On the Eozoic and Palæzoic Rocks of the Atlantic coast of Canada in comparison with those of Western Europe and the Interior of America." By Sir J. W. Dawson, LL.D, F.R.S., F.G.S.

The author referred to the fact that since 1845 he had contributed to the Proceedings of the Geological Society a number of papers on the geology of the eastern maritime provinces of Canada, and it seemed useful now to sum up the geology of the older formations and make such corrections and comparisons as seemed warranted by the new facts obtained by himself, and by other observers of whom mention is made in the paper.

With reference to the Laurentian, he maintained its claim to be regarded as a regularly stratified system, probably divisible into two or three series, and characterised in its middle or upper portion by the accumulation of organic limestone, carbonaceous beds, and iron-ores on a vast scale. He also mentioned the almost universal prevalence in the northern hemisphere of the great plications of the crust which terminated this period, and which necessarily separate it from all succeeding deposits. He next detailed its special development on the coast of the Atlantic, and the similarity of this with that found in Great Britain and elsewhere in the west of Europe.

The Huronian he defined as a littoral series of deposits skirting the shores of the old Laurentian uplifts, and referred to some rocks which may be regarded as more oceanic equivalents. Its characters in Newfoundland, Cape Breton, and New Brunswick were referred to, and compared with the Pebidian, etc., in England. The questions as to an Upper Member of the Huronian or an intermediate series, the Basal Cambrian of Matthew in New Brunswick, were discussed.

The very complete series of Cambrian rocks now recognised on the coast-region of Canada was noticed, in connection with its equivalency in details to the Cambrian of Britain and of Scandinavia, and the peculiar geographical conditions implied in the absence of the Lower Cambrian over a large area of interior America.

In the Ordovician age a marginal and a sub-marginal area existed on the east coast of America. The former is represented largely by bedded igneous rocks, the latter by the remarkable series named, by Logan, the Quebec Group, which was noticed in detail in connection with its equivalents further west, and also in Europe.

The Silurian, Devonian, and Carboniferous were then treated of, and detailed evidence shown as to their conformity to the types of Western Europe rather than to those of America.

In conclusion it was pointed out that though the great systems of formations can be recognised throughout the Northern Hemisphere, their divisions must differ in the maritime and inland regions, and that hard and fast lines should not be drawn at the confines of systems, nor widely different formations of the same age reduced to an arbitrary uniformity of classification not sanctioned by nature. It was also inferred that the evidence pointed to a permanent continuance of the Atlantic basin, though with great changes of its boundaries, and to a remarkable parallelism of the formations deposited on its eastern and western sides.

"On a Hornblende-biotite Rock from Dusky Sound, New Zealand." By Captain F. W. Hutton, F.G.S.

The rock is of eruptive origin, and is associated with Archæan schists and gneisses. It is compact, crystalline, of a dark green colour, and sp. gr. 3·00—3·07. It is composed of two minerals in nearly equal proportions, one of which, a black mica, has the two optic axes nearly coinciding. The other mineral is of a pale bluish-green colour, and moderately dichroic; it shows an aggregate polarisation of rather coarse grains, with here and there distinct crystals of considerable size. Often one side of a crystal shows a single twin, while the other side is polysynthetic. The optical characters are those of the monoclinic system, and further investigation proves these crystals to be hornblende. The mineral which shows aggregate polarisation is either crushed hornblende or some altered form of it.

MANCHESTER MICROSCOPICAL SOCIETY.

At the meeting held on May 3rd, Mr. Percy F. Kendall, Bishop Berkley Fellow and Assistant Lecturer on Geology at the Owen's College, read a paper on "Meteorites." He remarked that although meteorites belonged more to the domain of telescopy the microscope has revealed facts which have enabled scientists to draw important conclusions as to their internal structure. They have been known from remote antiquity, being mentioned by Greek writers of 2,000 years ago, and also by the Chinese, who have kept records of those observed during a period of 700 or 800 years. Yet their existence has lately been disputed by certain French scientists. A fall took place in France, and the Government sent an eminent scientist to investigate, and his report proved that in a considerable district of Normandy, a glare had been seen in the sky in daylight, accompanied by a series of detonations, and that a man had been struck by some object falling from the sky. Many stones were found lying on the ground, 2,000 of which were collected. These three phenomena—the passage of a fire-ball, a loud noise, and a fall of stones—have been observed over and over again, but it does not necessarily follow that they should all be observed in each instance. A remarkable fact about the fall of meteorites is that the detonation succeeds the fall of stones, proving that the meteorite travels faster than the sound. Mr. Kendall examined the phenomena seriatim, dealing first with the flash of light in the sky. Meteorites are small planets travelling in independent orbits *in vacuo*. They are consequently intensely cold. When they reach our atmosphere they meet a resisting substance which, although rarer than the vacuum obtained by an air-pump, offers considerable resistance to their passage. A high degree of friction is produced, and their exterior portion becomes white hot, possibly some of it being converted into vapour. This intense heating produces the light which we see. The external crust is fused, and flows over the surface, and drops falling off its posterior side go to swell the small luminous cloud which follows. Owing to the unequal expansion, the meteorite breaks, with the result that numerous fragments are scattered. As it proceeds, these fragments undergo the same process, and the whole mass is broken into numerous irregular fragments, often as many as 5,000. The rate they travel has been estimated as from 2 to 16 miles per second. The noise of the explosion and the closing of the air behind them are not heard until they reach the earth. Sound travels at the rate of 11,000 feet per second, and a period elapses, varying from one to six minutes, before the sound is heard. With regard to the course they take, they do not descend perpendicularly, but at a low inclination to the horizon, making a long path before they reach the earth. In one case the course was as much as 120 miles, the visible part being about sixty miles, the time occupied ten seconds, giving a velocity of twelve miles per second. Their actual fall

upon the earth is very rarely observed. In 1631 a fall took place upon a Swedish vessel in a French port, and two sailors were killed; and there are other instances on record of death by meteorites. There have been several falls in our own country within the last century, one in Shropshire and another in Yorkshire. They strike the earth with considerable velocity, and bury themselves deeply in the ground, sometimes as much as three or four feet, but sometimes, owing to their course being exceedingly oblique, they do not do so. A fall was observed in the Baltic where a stone rebounded from ice two inches thick. As to their temperature when they reach the earth, this has to be gathered from the evidence of witnesses of their fall. They are generally excessively hot when they reach the ground, for the reason before mentioned, but a case is on record that in India a native picked one up and dropped it immediately on account of its excessive coldness. This is explained by the fact that they are the same temperature as stellar space (about 250 degs. Centigrade) before they reach our atmosphere, a temperature so low that we have no conception of it, as it is much below the temperature required to liquefy gases, such as carbonic anhydride. They become heated owing to their rapid passage through our atmosphere; but, seeing that this passage only occupies a few seconds, the outer film of the meteorite only becomes heated, so that when it falls it rapidly cools by radiation, and the reserve of cold in the interior asserts itself. The meteorite breaks before it reaches the earth, and the fragments are found scattered over an elliptical area of country, the larger stones at one end and the smaller at the other. In one case the fragments were found over a district of 180 miles. The fragments are triangular in shape, and if placed together the result would be a large triangular body. They have a highly glazed surface, as if they had been black-leaded, traversed by minute ridges and furrows. This glazed surface extends only a fraction of an inch into the interior, and is found to be merely a film caused by the fusing of the material of which it consists. With regard to their chemical composition, about twenty-six elements have been found in them, all terrestrial. They contain, however, certain compounds which, under other circumstances, we should consider organic, such as oily substance of the nature of petroleum. Carbon is of common occurrence. Some of the minerals composing them are unfamiliar to us, but they are gradually being found on the earth; and it is expected that as soon as the mineralogy of this earth has been fully worked out they will all be found to exist on the earth. All the minerals occurring in meteorites have been classified, which is not the case with those composing the earth. Iron occurs largely, both free and combined with nickel, and also as a phosphite. There is also a sulphite which is not known as a terrestrial mineral. Iron never occurs as an oxide in meteorites, which is frequently the case on the earth. Meteorites contain gases imbedded in their pores, amounting to five or six times their volume at normal pressure. The gases which have been found are carbonic oxide, carbonic anhydride, hydrogen, and oxygen. They have fallen in all parts of the earth and at all seasons of the year, although more have fallen in South Carolina in the last twenty years than have fallen in all the rest of the world put together. The old records which have been collated show that about thirty-three years elapse between the great meteoric displays, and it has been computed that somewhere about the 15th November, 1898, a brilliant display may be expected. Several ingenious and startling theories have been put forward to account for them. Some say they are fragments thrown off the sun by some explosive action similar to volcanic action, and the moon and the earth have also been mentioned as their starting point. At one time it was reported that fossils had been found in meteorites, but this notion has been abandoned. Another very remarkable theory, and one hard to believe, was that our earth had been peopled by germs carried to it by meteorites.

NATURAL HISTORY SOCIETY OF GLASGOW.

The first meeting of the summer session was held on May 15th, Dr. Stirton, F.L.S., in the chair. Mr. R. M'Kay reported on an excursion made to Darnley Glen, near Nitshill, on the 12th ult. Among the specimens obtained was *Paris quadrifolia*, Linn. Mr. D. A. Boyd exhibited several species of land and marine Isopods from the neighbourhood of West Kilbride, including *Porcellio armadilloides*, *Idotea tricuspidata*, and *Næsa bidenta*. Mr. Thos. King exhibited *Morchella semilibera*, a fungus found growing at Darnley Glen (not previously recorded for the West of Scotland). Mr. R. Broom, B.Sc., brought forward a number of microscopical preparations illustrating the development of enamel and dentine. Before exhibiting these, he gave a short account of the various stages in the development of a tooth and of the individual dental tissues.

JUNIOR ENGINEERING SOCIETY.

At the concluding meeting of the present session of this Society held recently, a paper was read by Mr. F. W. Quick, C.E., on "The Elements of Stresses in Structures." Reference to diagrams and models assisted the author in his investigation of the character of stress to which constructional material under various conditions and circumstances was subject. After the reading of the paper, which was supplemented by additional information from the author, an animated discussion ensued. Arrangements are now in progress for the visiting during the summer months of several places of engineering interest in the vicinity of the metropolis.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

On May 24th Mr. G. F. Fenn read a paper on the "Land and Fresh-water Mollusca of the Southern Counties." The speaker explained the distribution of the various species, discussing their connection with the geology of the district. He pointed out the remarkable tendency to albinoism among the mollusca of the Isle of Thanet, a fact the more remarkable as Lepidoptera of the same locality incline to melanism.

Some conversation followed on the agreement or disagreement of the molluscous districts with those recognised in case of insects.

Roman Remains in the City.—The remains of the Roman wall, St. Martin's-le-Grand, may be viewed any Friday between 10 a.m. and 5 p.m., by orders to be previously obtained from the Secretary, Her Majesty's Office of Works, 12, Whitehall-place.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

RE-FORESTATION OF BRITAIN.

The suggestive article of your contributor, Mr. Mattieu Williams, by no means exhausts all the advantages sure to accrue from the forestation of our moorlands and wastes. One of the most important is the shelter which they afford against the wind, one of the greatest enemies of the British farmer and gardener. Practical American authorities have concluded that if about one-fourth of a region is left clothed with forests, the residual three-fourths will yield more abundant crops than would the whole if laid entirely bare.

Another advantage of the woodlands is that they afford ample shelter and resting-room for the small insect-eating birds which are so much needed to protect our crops.

PHILIBERT.

A CIRCLE PROBLEM.

How much farther does the outer handle of one of the carriages of an "Inner Circle" train travel in one journey than the inner handle, the circumference of the circle being 13½ miles, and the handles being 9 ft. apart?

It might be imagined by those who know that the ratio of the circumference of a circle to the diameter is as 3·14159 to 1, or more accurately 3·14159265358979322384624338 to 1, that the more simple and more easily remembered ratio of 3⅐ would not be accurate enough. Many persons would proceed thus:—Reduce the circumference to feet = 63360, divide by 3·14159 to find the diameter = 20168·1 ft. Take this as the distance travelled by the inner handle. The diameter of the track of the outer handle will be 18 ft. greater, or 20186·1 ft. The circumference of this circle is 63416·54 ft., or 56·54 ft. longer than the inner, say, 56 ft. 6½ ins.

A little reflection shows that the circumference of the circles has nothing to do with the problem, unless they are several thousand miles in diameter. The difference will always be the circumference of a circle 18 ft. in diameter.

If the track encircles the earth, the diameter would be about 25,000 miles in diameter, and the two rails being parallel, the distance travelled by the handles would be the same. If a telegraph line were set up alongside of this track, on poles 9 ft. high, the length of the wire would be 25,000 miles 56 ft. 6½ ins., supposing the diameter of the earth to be exactly that given above.

A. P. T.

THE NEBULAR THEORY.

It is said that a definite star in the constellation Cygnus has been seen to resolve itself into a nebula. How is this phenomenon to be reconciled with the theory of Laplace?

QUERIST.

ALKAHEST.

Is it possible that the "alkahest" of the old alchemists was, after all, fluorine? This substance certainly possesses the most striking property attributed to alkahest—that of attacking and dissolving all things. Is it possible that free fluorine can have been known in times of which all record has perished?

HERMES.

FLORA AND FAUNA OF HARD AND SOFT WATERS.

Can you refer me to any observations as to the comparative prevalence of aquatic plants, fishes, water-insects, etc., in hard and soft waters? My own impression is that the soft water streams, when not too rapid, are decidedly the richer.

E. G. C.

REMARKABLE AGE.—The *Medical Press* learns the reported death of a peasant of Moravia at the age of 142 years. He is said to have left a son aged 115 and a grandson of 85.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

SIGNALS.—Semaphore signals for railways have been patented by Mr. H. Skerrett. The invention consists in the combination with a hollow swinging arm, having a transparent front, of a light arranged exteriorly to this arm and means for reflecting the light into the cavity of the arm, and thence out through the transparent face of the same. It also comprises the combination with two movable semaphore arms of a single lamp and means for illuminating both blades from the one lamp.

GAS.—An apparatus for washing gas has been patented by Mr. J. H. Dinsmore, of Liverpool. A convenient way of lightly washing the gas to remove impurities is to cause it to pass below a number of inverted weirs, the edges of which are immersed to a small depth in the washing liquor. The receptacles for holding the liquor are arranged horizontally, and may be conveniently placed one above the other. A number of weirs are provided for each receptacle, so that the gas is subjected to repeated washings in each tray.

MUSICAL INSTRUMENT.—Mr. G. E. Mason has patented a stringed musical instrument. The instrument is trapezoidal in shape, its side being equally inclined to the ends. The strings are stretched across from the bottom of each side piece to the top of the opposite one, thus lying in two intersecting planes. The strings attached to the top of the one side are tuned to the scale of C major, the opposite ones producing the sharps and flats. Side sound-boards are placed between the two sets of strings, and a middle sound-board under both sets. A cover, open down the middle, gives access to the strings.

LAWN-TENNIS MARKER.—Mr. E. Snow has patented a lawn-tennis marker. It consists of a vessel for containing the marking material, provided with an opening at the bottom through which the liquid passes on to a marking wheel, by which it is conveyed to the ground when the machine is wheeled along, the flow being regulated by means of a valve. The valve is provided with a spike to prevent the stopping up of the outlet, and is normally closed by two spiral springs, being lifted when required by a cord which passes over a pulley and is connected with a lever handle. A scraper is fixed to the bottom of the vessel.

ALUMINIUM.—Mr. C. A. Burghardt has patented a solution for producing aluminium. The solution, from which the aluminium is to be extracted, is prepared as follows:—A quantity of aluminium sulphate is dissolved in water, the contained aluminium being precipitated as hydrated aluminium oxide by the addition of an excess of ammonia solution. The aluminium thus obtained is washed to free it from saline impurities, and is afterwards dissolved in an excess of caustic soda, thus forming aluminates of these metals. To the solution of aluminate is added a proportion of potassium cyanide, and the solution boiled for some time; potassium bicarbonate is then added, and the whole is boiled for twelve to sixteen hours, until the solution becomes clear; and finally, to make the solution deposit the metal in a bright condi-

tion, a small quantity of a solution of hydrocyanic gas is added.

ALARM GUN.—An alarm for scaring burglars, etc., has been patented by Mr. W. Burgess. The gun barrels have a slot, and are hollowed out to receive the cartridge; these are placed in a box, and the breech fixed in the slot, together with a damp-proof shield, a hole being made in the breech to keep the pin of the cartridge in position. When the guns are used on a block the waterproof shield is required, but when placed in a box they can be dispensed with. A knuckle-joint is introduced at the top of each barrel, and a sliding weight placed thereon. The knuckle-joints are set in motion by a spoked roller, which is rotated by clockwork. Above this roller is fixed the clockwork, on the spindle of which is a pulley attached by a chain to the spoked roller. The clockwork drives this pulley, and thus winds up the cord, causing the spoked roller to elevate the knuckle-joint in an upright position. This releases the weight, which descends upon the pin of the cartridge in the barrel and explodes the charge.

LOCOMOTIVE.—Messrs. W. P. O'Neill and F. O'Neill, Ireland, have patented a pneumatic tram-car locomotive. This locomotive can be easily fitted to any existing tram, and consists of a petroleum engine which actuates the air-compressing pump, the compressed air passing to a receiver and thence to a double-acting cylinder, which, by a connecting rod, transmits motion to a crank on one of the car axles. A vapour compressor is provided in connection with the compressor, having a moving endless belt, which absorbs water, whereby the air entering the compressor is moistened, thus greatly reducing loss of power in the compressor. Between the receiver and cylinder is a reducing valve, capable of adjustment from the engine platform, for allowing the air under pressure to enter the cylinder at a desired rate, the air thus adjusting itself and working expansively in the cylinder when going down an incline, at a higher pressure on a level, and a still higher pressure up an incline or starting. A centrifugal pump is also provided, as well as a water supply for cooling the cylinder of the petroleum engine.

ICE.—Mr. F. A. Smith has patented an apparatus for making ice. The apparatus comprises an outer and inner casing provided with non-conducting material between them. The interior of apparatus is divided into upper and lower compartments by a partition. The lower compartment is provided with shelves and a door, and is used as a refrigerating chamber, while the upper one is again divided to form the freezing and overflow chambers. A fresh-water tank is placed at the bottom of the overflow chamber, and is provided with a supply pipe connected to the main. A pipe extends from the bottom of the tank to near the top of the overflow chamber, and then down between the freezing and overflow chambers, and enters the freezing chamber at the bottom. This pipe is provided with a valve to regulate the supply of water to the freezing chamber. This valve is operated from outside by a hand-wheel. The freezing chamber is provided with cans for holding the water to be converted into ice. These cans are provided with flanges by which they are supported in a float, kept in position in the freezing chamber by a suitable guide rod fixed to the bottom of the chamber.

TECHNICAL EDUCATION.

MUNIFICENT GIFTS TO MANCHESTER.—The Manchester City Council will be asked at its meeting this week to sanction and materially support a scheme for the formation of a Whitworth Institute of Art and Industry on an extensive scale, and the provision of a woodland park and pleasure gardens. The scheme is formulated by the legatees of the late Sir Joseph Whitworth, who left a large sum of money to be expended by them for the benefit of the citizens and in sympathy with his known wishes. The proposals are to present to the city the private property known as Potter's-park, the erection and equipment of a museum of art and industry in the park, an enlargement of the present School of Art, the building of a central technical school to work in close relationship with Owen's College, and the establishment of manual training schools, which may form a link between the public elementary schools and the central technical school. The whole scheme (inclusive of the present buildings of the School of Art and Technical School), valued at £50,000, represents a capital outlay of close upon £300,000. Towards this the Whitworth legatees offer in land, buildings, and money, £135,000, to be supplemented by other donations in case the broad scheme suggested by them is carried out. The committee and guarantors of the Manchester Jubilee Exhibition have provisionally agreed to hand over for the purpose of the institute of art and industry their surplus, which is estimated at £40,000, and the governing bodies of the Technical School and the School of Art have expressed their willingness, on certain conditions, to hand over their property. The City Council will be advised by a special committee of their body to provide for the maintenance of the public park, and to obtain power to assist from the rates in the support of the institute. The annual expenditure on maintenance, etc., is estimated at £10,000. The museum of art and industry is to comprise five sections, as follows:—(1) Fine art, painting, sculpture, etc.; (2) industrial art, textiles, wood and metal work, pottery, etc., books of design, and patterns; (3) mechanical, chemical, and textile industries and models; (4) commercial raw products, samples and patterns from the colonies and foreign countries, sent home by our Consuls to show the industries and requirements of distant markets, with suitable expositions, lectures, etc.; (5) lecture hall and illustrative libraries, lectures, etc.

ANNOUNCEMENTS.

DUNDEE NATURALISTS' SOCIETY.—From the annual report of this Society it appears that the ordinary meetings of the Society, as well as those of the physical section, have been very successful. Nine papers had been read at the ordinary meetings of the Society, and a good record of work was shown in the physical section, fourteen papers having been read, many of which embodied the result of original research. The Society's library was stated to be growing in extent and usefulness. Some additions had also been made to the museum, notably a valuable collection of micro-lepidoptera. The Society's large collection of birds' eggs had been carefully arranged and classified by Mr. R. N. Kerr. Steps had also been taken to remedy the sad condition in which the collection of birds had fallen through dust, mites, and moths. The following appointments have been made for the year 1888-89:—President, Mr. James Durham; Vice-Presidents, Professor D'Arcy W. Thompson and J. Martin White; Honorary Secretaries, Mr. F. W. Young and Mr. Alexander P. Stevenson; Honorary Treasurer, Mr. Alexander Simpson; members of the Council, Professors Carnelley and Steggall, Messrs. John Nelson, R. N. Kerr, A. C. Lamb, and Allan Matthewson.

PLYMOUTH BIOLOGICAL LABORATORY.—This Laboratory will be opened on Saturday, June 30th. The Fishmongers' Company will entertain the Council and various friends and members of the Association at lunch on that day, and a large gathering is expected of those who are interested in this important undertaking. Unfortunately the state of Prof. Huxley's health will prevent the President of the Association

being present on the occasion. The annual meeting of the Association will be held at Burlington House on Wednesday, June 27th.

PRIZES FOR ART-WORKMEN.—The Council of the Society of Arts have determined, on the recommendation of the Committee of the Applied Art Section, to offer prizes to art-workmen, in certain classes of art-workmanship, under the following conditions :—

1. These prizes will be awarded to workmen only, and the work must have been executed in the United Kingdom or its dependencies.

2. The objects submitted for competition may be the work of one workman, or of several workmen working in combination. They need not necessarily be the property of the workman or workmen sending them in. Manufacturers or employers may exhibit articles on behalf of their workmen. In this case, besides the name of the manufacturer, the names must be given of all the workmen who have executed portions of the work, with a statement of the portion executed by each. If any prizes are awarded they will be given to the workmen, and a certificate, enumerating the award or awards, will be given to the manufacturer.

3. The objects in each class may be :—

(i.) Copies of existing works.
(ii.) Modifications of existing works.
(iii.) Original works.

It should always be stated under which heading (i.), (ii.), or (iii.), the objects are to be entered.

4. In awarding the prizes, the judges will take into account the following points :—1. Originality or beauty of design. 2. Fitness of treatment. 3. Excellence of workmanship.

5. Designs or working drawings will not be received in competition.

6. Before the award of prizes is finally made, the candidates must be prepared, if called upon, to satisfy the Council of their competency.

7. The works will remain the property of the competitor, or of the person from whom he has borrowed them for the competition.

8. Although great care will be taken of articles sent for exhibition, the Council will not be responsible for accident or damage of any kind.

9. Prices may be attached to articles sent in and sales made, and no charge will be made in respect of any such sales.

10. All the prizes are open to male and female competitors on equal terms.

11. When two or more workmen combine in the production of any article sent in for competition, the names of, and the respective parts taken by, each must be specified when the article is sent in, and the proportions must be stated in which they may have agreed, if successful, to divide any prize which may be awarded.

12. All articles for competition must be sent in to the Society's House on or before Tuesday, April 23rd, 1889, and must be delivered free of all charges. Each work sent in competition for a prize must be marked with the workman's name, or that of the manufacturer, or, if preferred, with a cypher, accompanied by a sealed envelope, giving the name and address of the workman or manufacturer. With the articles a description for insertion in the catalogue should be sent. The works will be exhibited at the Society's House, or, if the necessary arrangements can be made, at the South Kensington Museum.

13. The Council reserve the right of withholding any of the specified prizes, or of substituting smaller prizes, or varying in any way their respective amounts. Silver and bronze medals may also be given at the discretion of the judges. Certificates will be given to the winners of prizes.

The following are the classes in which prizes are offered for the Session 1888-9 :—

I. POTTERY (INCLUDING PORCELAIN AND EARTHENWARE) :

1. The body, any material.
a. Thrown, not shaved, first prize, £5 ; second prize, £2.
b. Shaved or turned, first prize, £5 ; second prize, £2.

2. Decoration.
a. Modelled and glazed, first prize, £10 ; second prize, £5 ; third prize, £3.
b. Painted under glaze, first prize, £10 ; second prize, £5 ; third prize, £3.
c. Enamel on the glaze, first prize, £10 ; second prize, £5 ; third prize, £3.

3. Stone salt-glazed ware.
a. Plain ; incised and glazed, first prize, £10 ; second prize, £5 ; third prize, £3.
b. Coloured or otherwise decorated, first prize, £10 ; second prize, £5 ; third prize, £3.

The art-workman must have designed the body of the pot as well as have executed the decoration.

All the specimens of pottery sent in for competition must be dated on the clay.

II.—STONE CARVING.

First prize, £25 ; second prize, £15 ; third prize, £10 ; fourth prize, £5.

The capital of a column, with square, circular, or octagonal abacus, not to exceed twelve inches in width.

III.—WROUGHT-IRON GRILLES.

First prize, £25 ; second prize, £15 ; third prize, £5.

A grille measuring not less than three feet superficial, nor more than five feet superficial.

The object for which the grille is intended must be stated —whether for a protective purpose, for outside a window, a street-door panel, or for inside as a window-screen, or for coil case, ventilator, etc.

LIVERPOOL ASTRONOMICAL SOCIETY.—The following gentlemen were elected as President, officers, and Council for the ensuing year :—As President, Mr. T. G. Elger ; as Vice-Presidents, Messrs. W. F. Denning, J. Gill, J. Hartnup, and H. Sadler ; as Editor and Librarian, Mr. I. H. Isaacs ; as Secretary, Mr. W. E. Rowlands ; as Treasurer, Mr. W. H. Davies. Council, Mr. T. W. Backhouse, Miss E. Brown, Messrs. T. W. Clarke, J. L. Coxon, W. H. Davies, jun., J. E. Gore, G. Higgs, Major F. E. Markwick, Messrs. W. H. S. Monck, W. Sang, K. J. Tarrant, and Major Watson.

ROYAL GEOGRAPHICAL SOCIETY.—The annual meeting of the Royal Geographical Society was held on May 28th, at the London University, General R. Strachey in the chair. The retiring Hon. Secretary (Mr. C. Markham) read the report, which stated that during the year there had been a net decrease of twenty-nine in the number of Fellows. The total number, exclusive of hon. members, was 3,391. The Chairman then presented the Royal medals for the encouragement of geographical science and discovery. The Founder's medal he handed to Mr. Clements R. Markham on his retirement from the Honorary Secretaryship of the Society after twenty-five years' service, and in acknowledgment of the valuable services rendered by him to the Society during that period. Also for his numerous and important contributions to geographical literature during the last thirty-five years, and in recognition of his merits as an active explorer in the Eastern Andes in 1853, and again in 1860, when engaged in connection with the propagation of Cinchona, and in Abyssinia in 1866-67 when acting as geographer to the expedition in that country. The other Royal medal, known as "the Patron's," was given to Lieut. H. Wissman in recognition of his great achievements as an explorer in Central Africa, which he has twice crossed from the Atlantic to the Indian Ocean, and especially for the arduous and adventurous journey in which he traced the course of the river Kassai from its upper waters to its previously-unknown confluence with the Congo. The President also announced the following awards :—The Murchison grant for 1888 to Mr. J. M'Carthy (Superintendent of Surveys in Siam), for his excellent map of Siam and the paper giving a *resumé* of his explorations in that country ; the Cuthbert Peek grant for 1886-7-8 to Major Festing, for his services as a cartographer on the Gambia river and the country in the neighbourhood of Sierra Leone ; the Gill Memorial for 1888 to Mr. Charles M. Doughty, as a contribution towards the expenses incurred on the map of Arabia, illustrating the recently-published account of his travels.

DIARY FOR NEXT WEEK.

Monday, June 11.—Aristotelian Society, at 8 p.m.—*Annual Meeting for Business.*

Tuesday, June 12.—Royal Colonial Institute, at 8 p.m.—*Wine-growing in the British Colonies;* by Mr. H. de Castella.
Gas Institute, at 10.30 a.m.

Wednesday, June 13.—Royal Microscopical Society, at 8 p.m.—*Additions to the Knowledge of the Carboniferous Foraminifera;* by Rev. W. Howchin.
Gas Institute, at 10 a.m.
College of State Medicine, at 4 p.m.—*Some of the More Important Diseases Common to Man and Animals;* by Mr. G. Fleming.

Thursday, June 14.—Camera Club, at 8.30 p.m.
Gas Institute, at 10 a.m.

Friday, June 15.—British Museum, at 3.30 p.m.—*On the Social Condition of the Babylonians;* by Mr. G. Bertin.

Saturday, June 16.—Geological Association. — *Excursion to Reading.*
Royal Institution, at 3 p.m.—*Count Tolstoi as Novelist and Thinker;* by Prof. C. E. Turner.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch London.—All letters, Britannia Tool Factory Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new applianes, metal-spinning, milling, etc., in an ordinary lathe; 3s. post free.—BRITANNIA COMPANY, Colchester.

Chisel Steel, 1 to 5 feet bars, $\frac{5}{8}$ to $1\frac{1}{4}$ octagon, 13s. per cwt.—GILBERT, Oxford Road, Sheffield.

Best Cast Steel for tools, taps, and dies, drills, 6d. per lb.—GILBERT, Oxford Road, Sheffield.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Dynamo, 120-candle power, improved armature, 100s. Photo. 5 stamps.—D. WALTON, Hebden Bridge, Yorkshire.

Dynamo, 60-candles, improved armature, 45s.; photo. 5 stamps. Castings, lamps, etc.; wire from 1s. 4d. per lb.

Dynamo, 30-candles, 28s.; 10-candles, 20s. Photo. 5 stamps each—D. WALTON, Hebden Bridge, Yorkshire.

Fretwork, Carving, Turning, Woods, Tools, and all requisites. Catalogue with 700 illustrations, 6 stamps.—HARGER, BROS., Settle.

Second-hand Lathes, and other tools, offered cheap; on view, Britannia Co., 100, Houndsditch, London.—Send 2 stamps for list, to Britannia Works, Colchester.

5in. Burnishers, 7s. 6d. Silver steel bar, warranted: $6\frac{1}{2}$ in., 12s. 6d.; 9 in., 20s.; 15 in., 40s.—C. C. VEVERS, Horsforth, Leeds.

Photographic Specialities, cheap and good.—Stills, head-rests, backgrounds, washing machines, lamps, shutters, etc. Lists free.—C. C. VEVERS, Horsforth, Leeds.

Tricycle, front steerer, Coventry make, good condition, £5, worth double.—ARMY CONTRACTOR, Granville, Sandgate, Kent.

To Emigrants.—Beautiful double Breech-Loader, splendid condition, 3 guineas, approval.—HILLSDON, Harbour House, Folkestone.

Small Electric Lamps, post free, 7 stamps. Electric Motors, powerful, well finished, 47 stamps.—P. ROWSELL, 1, Walcot Square, London, S.E.

3-in. Iron Borral, Copper, lined with Brass Fittings, ready for plank, for Sale or Exchange.

A Freshwater, or Counter Pump, Brass, ebony handle, Sale or Exchange. 5-in. Slide rest wanted, for above, and cash.—FREE CHILTON, 77, Park Street, Luton, Beds.

Gilding and Electro-plating Taught.—Amateur's Complete Outfit, with Instructions, 21s.; list, 1 stamp.—PERKS, Alexandra Road, Richmond, Surrey.

Dead Black Varnish for Cameras, Lenses, Dark Slides, etc.—Bottles, post free, 1s. 3d.—H. SOUTHGATE, Maidenhead.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers, Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

Manual of Artistic Anatomy, for the Use of Students in Art. By John C. L. Sparkes, Principal of the Government National Art Training School, South Kensington Museum. London: Bailliere, Tindall, and Cox. Price 7s. 6d.

Researches on Diamagnetism and Magne-crystallic Action, including the Question of Diamagnetic Polarity. By John Tyndall, D.C.L., LL.D., F.R.S. London: Longmans, Green and Co. Price 12s.

A Manual of Practical Assaying. By John Mitchell, F.C.S. Edited by William Crookes, F.R.S. Sixth Edition. London: Longmans, Green and Co. Price 31s. 6d.

The Naturalist in Nicaragua. By Thomas Belt. With Map and Illustrations. London: E. Bumpus. Price 7s. 6d.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, May 28th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	43·1 degs., being 1·8 degs. below average.	4·9 ins., being 0·2 ins. above average.	359 hrs., being 15 hrs. below average.
England, N.E.	43·9 ,, ,, 2·6 ,, ,, ,,	4·3 ,, ,, 0·2 ,, below ,,	327 ,, ,, 36 ,, above ,,
England, East	44·8 ,, ,, 3·7 ,, ,, ,,	3·7 ,, ,, 0·4 ,, ,, ,,	338 ,, ,, 91 ,, below ,,
Midlands ...	45·1 ,, ,, 3·0 ,, ,, ,,	2·9 ,, ,, 0·8 ,, ,, ,,	316 ,, ,, 61 ,, ,, ,,
England, South	45·6 ,, ,, 3·6 ,, ,, ,,	3·3 ,, ,, 0·1 ,, above ,,	326 ,, ,, 73 ,, ,, ,,
Scotland, West	43·7 ,, ,, 2·0 ,, ,, ,,	6·1 ,, ,, 0·6 ,, ,, ,,	376 ,, ,, 8 ,, ,, ,,
England, N.W.	44·1 ,, ,, 3·2 ,, ,, ,,	2·9 ,, ,, 1·1 ,, below ,,	339 ,, ,, 43 ,, ,, ,,
Scotland, S.W.	45·7 ,, ,, 3·4 ,, ,, ,,	4·4 ,, ,, 1·0 ,, ,, ,,	384 ,, ,, 45 ,, ,, ,,
Ireland, North	44·9 ,, ,, 2·8 ,, ,, ,,	5·0 ,, ,, 0·1 ,, ,, ,,	338 ,, ,, 42 ,, ,, ,,
Ireland, South	46·6 ,, ,, 2·4 ,, ,, ,,	5·2 ,, ,, 0·3 ,, ,, ,,	386 ,, ,, 33 ,, ,, ,,
The Kingdom...	44·7 ,, ,, 2·8 ,, ,, ,,	4·3 ,, ,, 0·3 ,, below ,,	349 ,, ,, 45 ,, ,, ,,

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 24. (*New Series.*) FRIDAY, JUNE 15th, 1888. [Weekly, Price 3d. By Post, 3½d.

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SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

It is difficult to name any subject on which popular fallacies are more generally prevalent than that of arctic climate. If a speaker at an ordinary public meeting were to refer incidentally to the oppressive heat of a sultry summer day in the arctic regions his audience would accept the description as a joke, and be amused accordingly.

This is not at all surprising, seeing that most of our text books on physical geography, including those that adopt the word "physiography," and are therefore up to the latest fashion, give countenance to the popular fallacy by such exposition as the following, which I copy from one of the most widely circulated books on the subject.

"The reason why the sun heats the equator and the regions adjoining more strongly than it heats the temperate and polar regions is that at the equator it rises higher in the heavens and shines more directly downwards." This is illustrated by a diagram contrasting the tropical with the polar *summer* incidence.

It is true that effect of the solar rays upon a given area of the earth's surface is diminished by obliquity of incidence, and mathematical readers will understand that this varies with the sine of the sun's altitude, and therefore runs down to zero when the sun is on the horizon.

Taking this alone, the above quoted paragraph appears to be sound, but there is another factor which is omitted, and this factor is so predominating in determining the peculiarities of arctic climate, that the others are but insignificant. This factor is the length of the arctic days and arctic nights.

The summer day at the North or South Pole is 365 times longer than the summer day at the equator, 6 months against 12 hours (omitting the lengthening effect of refraction), and at the polar midsummer the altitude of the sun remains unaltered during the whole 24 hours, his apparent path being a circle constantly at 23½ degrees above the horizon. At the equator and other tropical regions when the sun is perpendicular at midday, he completes his apparent semicircular path from horizon to horizon in 12 hours, and therefore his mean altitude is but 45 degrees, and this for only 12 out of the 24 hours. Thus we have to compare 45 degrees for 12 hours against 23½ degrees for 24 hours, and this, when worked out for the sines, gives the polar midsummer day an advantage represented by 397 against 292, or in round numbers 4 to 3. Therefore, regarding the obliquity of the solar rays alone, the hottest summer climate on the earth is at the poles. The diagram above referred to proves exactly the contrary to that which is intended.

I take the above figures from Dr. Zenker's recent work on the Distribution of Heat over the Surface of the Earth, for which, in spite of the nationality of the author, he has received a prize from the French Academy; and am glad of the opportunity of doing so, having been described as a paradoxer for maintaining similar conclusions in the *Gentleman's Magazine*, etc.

My attention was first directed to the subject by practical experience in the course of a visit to merely the fringe of the arctic regions in 1856, when I found the thermometer at 108° in the sun out at sea and 92° in the shade of a cabin built on deck, in latitude 70° N. It was doubtless hotter on shore. I found it so in the course of an excursion up the Tromsdal, but had no thermometer with me then.

The figures of Dr. Zenker refer only to the theoretical efficiency of the sun upon the earth, irrespective of the atmosphere which obstructs more or less the passage of the solar heat. The variation of this is more marked in the arctic regions than in the tropics. I had a striking experience of this in the course of a second visit to the neighbourhood of the North Cape in the summer of 1875, which was misty and cloudy. The weather was then decidedly cooler than at the same season in England.

But we must not forget that even the heat which fails to penetrate the misty air is not lost, but is absorbed by the air itself. The sun does the same amount of work, but that which fails to warm the surface of the earth is warming the air above it.

Here in England we sometimes have a few summer

days that old Indians tell us are as oppressively hot as those of Calcutta, some say even more so. The cause of this is similar to that described above. Although the sun does not rise so high at midday, it is higher in the morning and evening over London at summer time than over Calcutta. Usually we are screened by our less transparent atmosphere, but there are days when even our British sky is as clear as that of the tropics.

The dominating cause of the bitterness of arctic climate is the long arctic night—the months of darkness during which the earth is continually radiating into space the heat it has received from the sun. The effect of only a few hours of such radiation is shown by comparing the temperature of the earth's surface at 3 p.m. with that of 3 a.m. in our own summer time.

Thus when the time arrives for the departure of the sun from the arctic and antarctic regions, they cool down continuously, are only prevented from reaching the temperature of space by the atmospheric clothing which checks this radiation to some degree, but in a less degree than it checks the radiation here and nearer the equator. This diminished efficiency of the atmospheric jacket is another important factor co-operating with the long continuance of the outflow of heat.

The reason why the atmosphere does less for the protection of these parts of the earth is that it contains far less aqueous vapour than in those regions where the night is not long enough for the condensation to become as nearly complete. But this aqueous protection is not altogether lost. The dry land of the polar regions receives it in another form of protecting jacket—that of snow, and hence it is quite possible that certain regions may exist close to the poles, even at and around the poles themselves, where the ground may be barely frozen during the winter, in consequence of receiving a deep coat of snow immediately the long night begins, and when this is melted by the returning sun, a rich vegetation may spring forth and flourish luxuriantly, as it actually does in those parts of Siberia where the winter temperature of the air is lower than in any other known region of the world.

At such places, *i.e.*, on inland arctic plains, the greatest possible variations of climate occur. There the continuous summer rays go on heating and heating the soil, with little variation, during every twenty-four hours, with no variation at all at the actual poles, and the continuous winter radiation through the less resisting air brings the winter temperature at the snow surface nearly to that of outer space, or the lowest possible.

But there are arctic regions where the summer is cold. It is so at Smith's Sound, for example, just where our arctic explorers have done most of their work. These are glacier regions, where the ice from the mountains is pouring down into the sea to form a freezing mixture with the oceanic salt. This summer climate is quite different from normal inland arctic summer.

THE ATMOSPHERE ON THE SUMMIT OF BEN NEVIS.—Although the air at this station is most frequently saturated with moisture, there occurs at irregular intervals dryness exceeding anything hitherto recognised in the Sahara, in the deserts of Central Asia, and in the north of Mexico. Such exceptional dryness, was observed in 1886 from 1 a.m., March 11th, until the night between the 12th and the 13th.

FURNACE FOR LOW-CLASS FUEL.

PROBABLY few of our readers have any conception of the enormous quantities of small coal which is treated as waste at the pits. We refer to that which is too small for domestic use, or for the firing of steam boilers, etc. Some of it is sold for blacksmiths' forges, but a very large proportion is treated as not worth the cost of carriage. This is due, not to any unreasoning prejudice, but to the real difficulty of burning it on ordinary grates without a considerable loss. When the coal is very small, and is mixed with a good deal of dust, much of it falls through the grate bars; and if this be prevented by placing the bars close enough together there is an insufficient supply of air to the fuel, unless there is a very strong chimney draught. A strong draught of air, however, means a considerable loss of heat carried away by convection up the chimney.

In some cases the difficulty has been overcome to a certain extent by mixing a little tar with the coal dust, and then pressing it into the shape of bricks. This usually goes by the name of "patent fuel," and is chiefly used for marine boilers, and for railway locomotives in France and other continental countries. It is not much used in this country, as the expense of making the bricks renders this fuel as dear as good coal of large size.

With these facts before him, M. Michel Perret, of Paris, has for a long time endeavoured to construct a furnace in which low-class fuels of all kinds and coal or coke dust could be burnt. We know that he has achieved a considerable measure of success, and think, therefore, that many of our readers will be interested in having some particulars of his invention. The furnace he first introduced is shown in section in Figs. 1 and 2, and this he exhibited at the Smoke Abatement Exhibition held at South Kensington. The leading feature of the furnace is that there are several shelves or floors, on which layers of fuel a few inches thick are placed, and the air, admitted at the bottom, gradually travels over the surface of the fuel on all the shelves until the whole of the oxygen is taken up. After the furnace has been started with a little fire on each shelf fresh fuel is put on the top shelf, and from this it is raked on to the shelf immediately below, and from the second shelf on to the third, and so on successively. In this way a large surface of hot fuel is exposed to the oxidising influence of heated air, and by the time the residue is raked on to the grate at the bottom complete combustion of the carbon has taken place, and there is nothing left but clinker and ash. The chimney draught required is very slight, because the air does not have to pass through the fuel, as in an ordinary furnace, and it is easy to regulate this to a great nicety, and this is another source of economy.

More recently M. Perret has introduced the furnace shown in Figs. 3 and 4, in which he uses a series of narrow shelves, prismatic in section, instead of the wider shelves shown in Figs. 1 and 2. The whole furnace is charged with fuel, and the narrow shelves are so arranged that as the fuel burns away below its place is taken by fuel falling down from the top, and in this way he avoids the labour of raking the fuel from one shelf to another, as in Figs. 1 and 2. It is probable that in the new arrangement there is some slight loss of fuel, owing to the formation of carbonic oxide caused by the reduction of some of the carbonic acid formed in the lower strata of the fire. On the other hand, the furnace can be charged and left for twenty-four, and it is said even forty-eight

hours, while the temperature remains nearly constant. The furnaces can be worked with the dust of coke, anthracite, or any non-caking coal, or with larger coal of very poor quality, yielding as much as 30 to 40 per cent. of ash.

As regards the purposes for which such furnaces are suitable, we may mention that they are used for drying and evaporating of all kinds. They are much used in France and Belgium for heating malting floors, also for heating pans and other apparatus in sugar refineries. They serve also for heating, fumigating, and disinfecting chambers, for drying fruits and many other articles of food. In France they are also used extensively for heat ing churches, schools, hospitals, and other buildings. In this country, however, there is a decided and reasonable preference for heating buildings by a circulation of hot water, but for the thousand and one purposes for which drying and heating are required in manufacturing processes M. Perret's system is deserving of close attention.

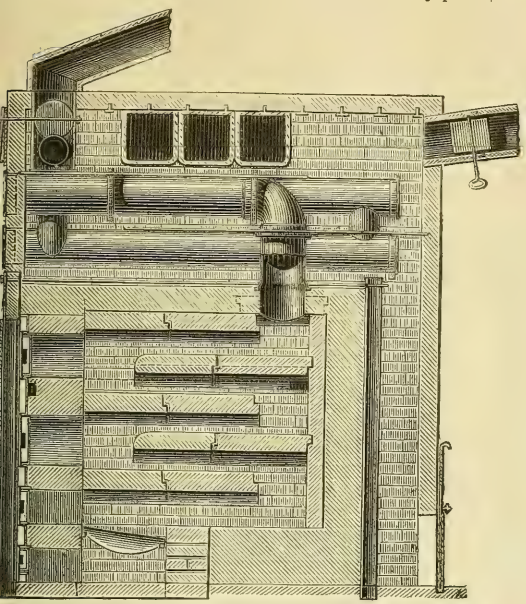


FIG. 1.—LONGITUDINAL VERTICAL SECTION.

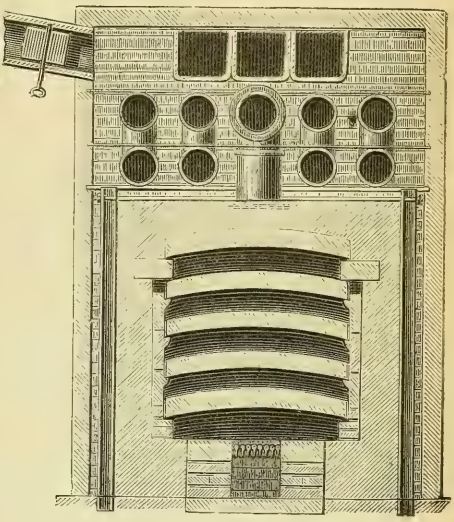


FIG. 2.—TRANSVERSE VERTICAL SECTION.

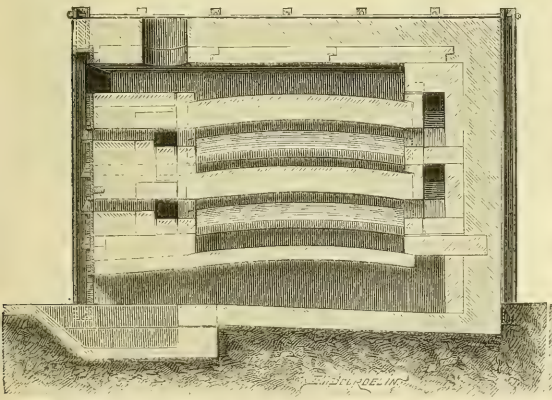


FIG. 3.—LONGITUDINAL VERTICAL SECTION.

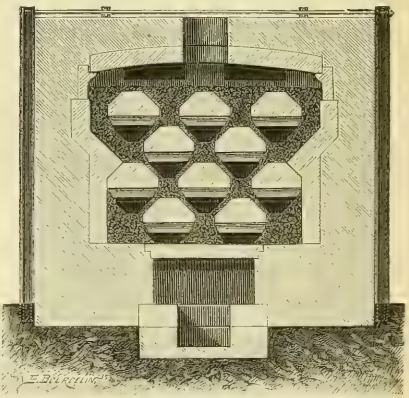


FIG. 4.—TRANSVERSE VERTICAL SECTION.

RESISTANCE OF FIRE.

OUR organism naturally revolts at burns and scalds with all the energy of a deep-seated instinct. Wild animals are afraid of fire; and children, when once burned, proverbially dread it. This horror of burning makes people admire those who can defy it. A man is a hero who can handle live coals or red-hot iron, who can touch melting lead, or who can resist flames and boiling oil. But to plunge the hand into molten metal has been a feat known from the earliest times. Zoroaster, wishing to confound his accusers, invited them to throw upon his body molten bronze, which did him no harm. And in our day, it is no uncommon thing for workmen to plunge their hand into a basin of molten lead for a piece of silver which a visitor throws in to try them. In the foundries workers can be seen stopping with their hand a jet of molten cast-iron rushing from the crucible. Professor Heddle, of St. Andrew's University, used to scoop out with his naked hand boiling lead from a crucible in the chemistry class-room—a feat which raised him infinitely higher in our estimation. It is stated on the highest authority that in a baker's oven, at a temperature far above the boiling point of water (on one occasion even 320° Fahr.)—so high, indeed, that a beefsteak was cooked in thirteen minutes—Tillet in France, and Chantrey in England, remained nearly an hour in comparative comfort; and, though their clothes gave them no great inconvenience, they could not hold a metallic pencil-case without being severely burned.

The Greek and Roman authors have handed down to us the account of the extraordinary power which some had of resisting fire. The priestesses of Diana and Castabala, of Cappadocia, arrested the veneration of the faithful by walking with their naked feet over burning embers. The Hinpi, during the annual festival in Etruria, performed the same feat. In Hindostan, it is stated that Sitah, wife of Ram, in order to exculpate herself from grave suspicions, walked bare-footed over red-hot iron. "The foot of Sitah," say the Hindoo historians, "being enveloped in innocence, the devouring heat became for her a bed of roses." The Thebans, accused in the "Antigone" of Sophocles, cried out, "We are ready to handle burning iron and to walk through flames to prove our innocence." At the beginning of the eleventh century, Poppon, with the object of drawing Suenon II., King of Denmark, and his subjects to Christianity, placed his naked hand and arm into a crucible of iron raised to white heat, and walked through the midst of the terrified Danes to the feet of the prince, to show he was uninjured. Soon after, Harold, son of Magnus, King of Norway, proved his right to the throne by marching with impunity barefooted over red-hot iron plates. In Africa, Portuguese travellers have seen Kaffirs justifying themselves against an accusation by handling red-hot irons. Among the proofs to which the apprentice sorcerers among the red-skin Indians submitted on the day of their dedication, was found that of walking over burning wood.

The proof of fire was, in the Middle Ages especially, reserved for persons who, by reason of their old age or invalid state or profession, could not justify themselves against accusations by fighting their accusers in the open field by the judicial duel. This proof had a religious character: it was executed in the church under the direction of the clergy. The iron bars were consecrated, and the priests directed all the preparations. To prevent anything being put on the hands of the accused, these were covered up and placed under seals for several days before the trial.

It was only at the end of the seventeenth century that the question of human resistance to fire was considered from a scientific point of view, and that was in 1677, by Dodart, a member of the Academy of Sciences, in Paris. This examination was excited by the marvellous experiments which were then performed in Paris by a chemist, named Richardson. Richardson walked barefooted over burning coals. He melted sulphur, placed it all ablaze on his hand, and then deposited it on his tongue. A small piece of meat was cooked on burning coals which were placed on his tongue. He held in his hand a red-hot bar of iron, and then transferred it to his teeth. Dodart explained these experiments without the help of chemicals. He observed that the skin by practice gets thick and impervious to heat; he considered that it was on account of the thickness of the skin of their feet that the Arabs are able from their infancy to walk on the burning sand.

There are several interesting cases in which preparations were placed on the skin to aid in resisting the heat. At the beginning of the century, Sementini, Professor of Chemistry in the University of Naples, gave an account of a celebrated acrobat, Lionetti, who performed wonderful feats. This man began by putting a bar of red-hot iron through his hair without burning his hair; he then passed it down his arms and legs. He nipped off a bit of iron at a white heat with his nails; he then drank boiling oil. He dipped his fingers into boiling lead, and put drops on his tongue. But Lionetti was observed to put some dark powder on his head, arms, legs, and tongue. The Professor made experiments to find out the secret, and at last found that sulphurous acid rubbed on had a slight power of resisting heat; that a solution of alum acted better; and that soap over the alum was even more effectual. He discovered that a layer of powdered sugar covered with soap was sufficient to render even the tongue completely insensible to the heat; and he performed Lionetti's feats before his astonished class in the University.

But there is a natural way of explaining most of the remarkable feats. Without entering into details which are found in treatises on physics, we may mention that a drop of water, falling on a plate of metal intensely heated, instead of immediately passing into vapour, as when the plate is much cooler, assumes the form of a small spheroid and remains in that state until the plate is sufficiently cool to enable it to vaporise. Thus the vast number of little particles of water which occupy the pores of the skin (and the number of pores is at a maximum in the palms of the hands), finding themselves suddenly in contact with a body, as boiling metal, whose temperature is exceedingly high, are thrown into the spheroidal state, and are interposed between the metal and the surface of the skin, forming for the skin a true protecting glove. This circumstance, with firmness and practice, enables the experimenter or acrobat to perform many marvellous feats, which, unfortunately, lose their charm when the secret of their execution is unveiled.

THE CHINESE INUNDATIONS.—Some of the districts flooded by the outburst of the Hoang-Ho seem likely to become permanent lakes. Extensive and expensive pumping operations are in contemplation.

REMARKABLE HAILSTONES.—I.

HAILSTONES occasionally assume shapes and sizes not easily accounted for. In their ordinary form they may be regarded simply as drops of water which in their descent have encountered a colder stratum of air and have been frozen. But the case is often exceedingly complicated: we hear authentic reports of hailstones formed of concentric layers, like the coats of an onion; alternately of clear, hard, transparent ice, and of a loose, opaque matter, like compressed shots. Perhaps the most remarkable hailstorm on record is one mentioned by Abich as having occurred near Teflis in the summer of 1871. The stones were of the size of a hen's egg, a magnitude by no means unexampled. On examination there was found in almost all a central spherical or spheroidal nucleus coated in part with a crystalline structure, thus indicating two distinct phases in their formation. The nucleus was a spheroidal body of pure ice, enclosing a number of fine air-bubbles, and consequently not very transparent. Of the same texture was an intermediate layer, enclosed in a whitish stratum. From this nucleus there issued a number of whitish radiating stripes, like the spokes of a wheel. The space between these six radii was almost pure ice, translucent like that of a glacier, and containing a number of small pear-shaped pores, which seemed to issue from the centre.

From the surface of the central bodies as thus constituted there arose crystals of pure, transparent ice, sometimes singly and sometimes grouped together, as in Figs. 1 and 2. Their forms were often slightly rounded by the fusion of the edges and surfaces. In these crystals the rhombohedric system was distinctly represented in numerous modifications. Most frequently these crystals consisted of short six-sided prisms with obtuse rhombohedric terminal surfaces. Frequently also there projected prismatic crystals of nearly three-fourths of an inch in length, with converging edges, produced probably by the most acute rhombohedra. With these crystals there were also grouped the hemihedric forms of the scalene octohedron with rhombohedric terminal surfaces of considerable size.

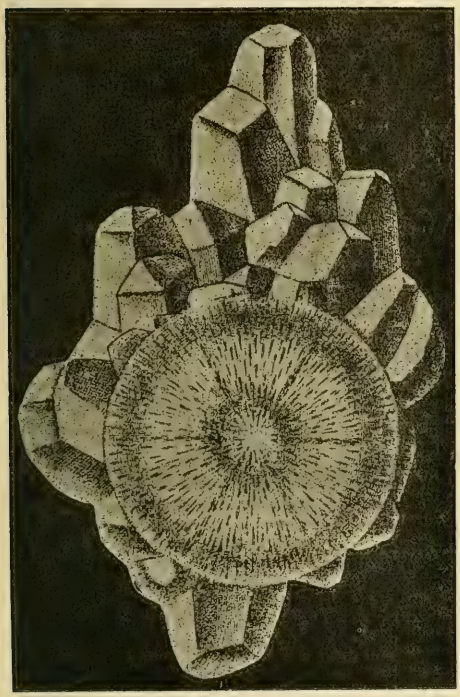


FIG. 1.

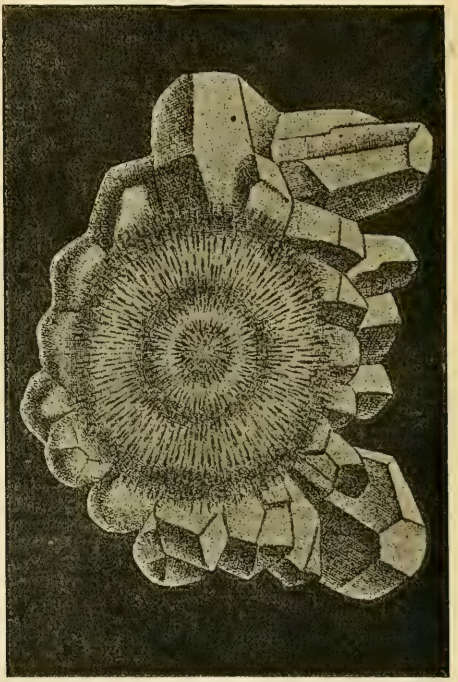


FIG. 2.

Along with these columnar formations, which reminded the observer of the calcareous spar crystals from the Andreas mine, there occurred also clear crystals with expanded end surfaces and dihexahedric terminal edges, which resembled the well-known forms of specular iron ore. At the beginning of the storm Herr Abich had observed certain tabular crystals arranged in flower-like circles like the "iron-roses" of St. Gotthardt. But he could not find any such specimens among the heap of hailstones which had been collected for examination. It will be understood that the descriptions of the hailstones, or rather hail-masses, as just given, cannot be regarded as the result of a formal, minute, crystallographic examination. In executing the drawings Herr Abich aimed at a correct reproduction of the lines

which were distinctly visible without any conscious regard to the crystalline form enclosed. In completing the figures no attempt has been made to correct or supplement angles and planes which had not been distinctly reproduced.

(To be continued.)

THE COPPER AGE IN EUROPE.

THE question of the first acquaintance of primitive man with metals ranks among the most important points in the study of the times which elapsed before the origin of written history, or even of surviving tradition. Among those which came into use in the so-called neolithic age is copper, which on account of its pliability could be wrought when cold, even in an unrefined state. A very interesting account of the earliest occurrence of copper tools in Europe has been published by Dr. M. Much, and has been summarised and criticised by Dr. C. Mehlis, in *Humboldt*.

There are found in the Mondsee, the Attersee, the Laibach lake, and among the pile-dwellings of western Switzerland, axes and knives of pure copper (*i.e.* not bronze). Similar tools are also found in the pile-dwellings of eastern Switzerland. Hence Much regards it as an established fact that in the pile-dwellings of Switzerland and Austria copper is met with in quantity before any other metal, and long before the cessation of the use of stone implements.

The European articles of copper, unlike those of North America, are all of them cast, and are of very primitive forms, belonging evidently to the neolithic age. Some of the tools, especially the axes, show a direct connection with corresponding articles of stone.

Among these copper implements there is most frequently found, from Denmark to Italy and from Asia Minor to Spain, a flat axe with a broad edge. We often meet also with weapons, daggers with a short blade to which the handle is secured by means of rivets. Less common are knives and spear-points.

Among tools there are found hammers, (especially in Hungary) needles, awls and sickles. Ornaments are also discovered, such as single and double spiral rings, bracelets, earrings, and hair-pins.

Dr. Much enumerates two hundred places in the Mediterranean regions where such articles have been found. All the implements—more than a thousand in number—have a very primitive character; they show no attempt at ornamentation, and agree with the neolithic forms. This internal evidence, taken in conjunction with the circumstances under which these relics are found, render it certain that the origin of these copper products must be sought for in the neolithic age.

It must be remarked that in the districts where these copper tools, etc., were found, crucibles, ladles for casting, and other metallurgical appliances, have also been met with. The author proves the occurrence of copper and its prehistoric extraction in the territories of Salzburg and in Tyrol.

Articles of bronze, very simple in form—especially flat axes—are found in the pile-dwellings on the Rhine, and in Asia Minor along with implements of stone and of copper. This fact furnishes Dr. Much with evidence that working in bronze was not introduced into Europe as a fully developed art, but that it has been evolved here from crude beginnings, proceeding on the lines, so to speak, of the stone age.

A certain progress is, however, evident if we compare even the oldest bronze articles with the archaic character of the copper implements. Dr. Much, founding his opinion upon the prevalence of copper ores in central Europe, and on the evident disposition of neolithic man to seek up useful materials, comes to the conclusion that the neolithic races settled in Europe must have made the independent discovery of the properties of copper and of its extraction by fire.

Dr. Much summarises his results in a series of propositions which meet with the general acceptance of archæologists. These are:—

1. Among all the metals copper was the first to become known to the people of Europe, inclusive of the Greek islands and the western coast of Asia. Its use spread almost over the whole of this quarter of the globe, and may be recognised even in the earlier days of the so-called neolithic (later stone) age. Copper was employed for a long time along with stone and bone utensils, and was not confined to ornaments, but served mainly for tools and weapons. For a time it retained the old shapes of the stone articles, which were improved only by degrees.

2. The copper implements in the possession of the European peoples were not obtained by barter from foreign nations, but were of domestic production, the produce of local mines and local furnaces. It is probable that the population of those days, which belonged to the Aryan race, had discovered copper independently.

3. Gold also became subsequently known, but without extending itself in the same time over the whole region in which copper wares have been discovered. On account of its small quantity and inadaptibility for tools, it served merely for ornaments, and did not acquire the high importance of copper.

4. Before the complete disuse of stone implements, there appeared the knowledge of the composition of bronze. The articles of this material retained, though only for a shorter time, the shapes of stone implements, taking up then the more advanced patterns of the copper utensils, and ultimately evolving a rich treasure of designs

Dr. Mehlis, however, does not feel free to follow Dr. Much in his denial of the existence of a neolithic age in Europe. He refers, in opposition, to the graves of Monsheim and Kirckheim, on the Rhine, which contain not a trace of metal; further, the graves of Merseburg, on the Saale, in which there are found stone implements, but neither copper nor any other metal.

It is a remarkable fact that the neolithic tribes of central Europe seem to have become more quickly and more extensively acquainted with the use of copper the nearer were their dwellings to the Alps and the Carpathians.

A closely connected question is that of the race which mined and forged cast articles of copper. Both Much and Mehlis conclude that the people who erected the pile-dwellings of central Europe must have been of Aryan blood. This race, in possession of domestic animals, the ox, the sheep, the goat, the dog and the swine; cultivating wheat and barley, and familiar with the arts of grinding stones, of pottery, weaving, spinning, smelting and casting copper, must have been firmly established in the neolithic age along the border of the Alps, and have spread thence northwards along the river valleys. The Aryans, at their first appearance in Europe, were not nomad, but agriculturalists, ethnically unconnected with the hunters of the mammoth and the reindeer.

General Notes.

THE BRITISH MUSEUM.—We understand that Mr. Edward A. Bond has resigned the office of Principal Librarian at the British Museum, which he has held with much distinction since August, 1878.

ARSENIC IN PAPER HANGINGS.—A controversy as to the presence or absence of arsenic in paper-hangings is at present going on between certain manufacturers and some importers. Each party, we are sorry to see, is supported by the testimony of experts.

AERIAL NAVIGATION.—A M. Jovis is about to set out from New York to Europe in an air-ship of his own contrivance, in company with five other adventurers. He hopes to cross the Atlantic in three and a-half days, and to arrive somewhere on this side of the water.

DANGERS OF MILK IN HOT WEATHER.—Dr. J. C. Vaughan, of the University of Michigan (*Popular Science Monthly*), argues against giving milk to children in summer, from its liability to generate the poison tyrotoxicon, supposed to be the immediate cause of summer diarrhœa.

EARTHQUAKE SHOCKS.—Shocks have been experienced during the month of April in the Scandinavian peninsula. At Kalleli, on the Lyse Fjord, in Norway, the concussion was strong enough to stop clocks. Shocks were felt also at Gjoesdal on the same coast, and in the south of Sweden, at Wexio.

NOVELTY IN AERONAUTICS.—It is now proposed to abandon the modern gas-balloon and to return to the original plan of Montgolfier, using rarefied air as the expansion agent. To cut off the possibility of ignition, balloons are to be constructed not of varnished silk but of a light asbestos tissue.

CONTINUOUS V. ALTERNATING ELECTRIC CURRENTS.—A striking distinction between wires carrying respectively currents of these two kinds is that the former, *i.e.*, those conveying continuous currents, quickly become coated with particles of dust, blacks, etc., whilst wires supplying alternating currents remain clean.

PROPORTION OF OXYGEN IN THE AIR.—Professor Hempel (*Ciel et Terre*) publishes the results of simultaneous analyses of air made in different parts of the earth. The results were, at Para, 20·92; Bonn, 20·92; Cleveland, 20·93; Dresden, 20·93; Tromsö, 20·95. The general mean proportion was 20·93.

THE GREENLAND EXPEDITION.—Dr. Nansen's expedition set off from Leith for Iceland on May 8th. It includes, besides Dr. Nansen himself, Lieutenant Dietrichsen and MM. Sverdrup and Kristiansen, all athletic young men, adepts in the use of the snow-shoe, and two Laps, named Balta and Ravna. We can only wish that they may re-appear in safety.

GIFT TO THE VIENNA OBSERVATORY.—We gather from the *Times* that Baron Albert Rothschild has purchased the large reflecting telescope that has been constructed at Paris for 40,000 florins and has presented it to the Vienna Observatory. A gallery for it has been built and endowed by the Baron. The total cost of this scientific gift will amount to upwards of £8,000.

FURTHER OBSERVATIONS ON THE PLANET MARS.—M. F. Terry (*Comptes Rendus*) mentions that he has seen three small, round brilliant spots situated on the prolongation of the *Erebus* at its western margin. These white points scarcely visible at first, become whiter and more brilliant as they approach the limb of the planet. The black line which seems to divide the northern polar cap has been perfectly visible since May 12th.

THE SLOW COMBUSTION OF ORGANIC MATTER.—M. Théophile Schloesing (*Comptes Rendus*) has examined the part played in the heating, and occasionally in the spontaneous combustion, of organic matter by microbia. He concludes that such combustions begin under the influence of microbia which play the part of igniters. This influence ceases between 104° and 122° F., giving place to a purely chemical combustion, which increases with the temperature.

THING-KNOWLEDGE *v.* WORD-KNOWLEDGE.—Says the Earl of Derby, "the farm labourer, who has learned to watch and understand the signs of the weather, to be knowing about stock, and who can use his hands skilfully, though he may be backward in book-learning, is quite as well instructed in any worthy sense as the prize prig stuffed with scraps of miscellaneous information, but knowing little at first hand, unaccustomed to observe, ignorant of animals, trees, flowers, or country life, and unskilled in any craft or in the handling of any tool."

ENORMOUS SPECIMENS OF ROCK CRYSTAL.—Some splendid specimens of rock crystal from Ashe County, in North Carolina, were exhibited by G. F. Kunz at the last meeting of the American Association. Among the most remarkable crystals are one weighing 20 lbs., half distorted, but exceedingly clear; one weighing 188 lbs., and another weighing 285 lbs., and being 29 inches long, 18 inches wide, and 13 inches thick. The pyramidal termination at one end is perfect. Dozens have been found weighing from 20 to 30 lbs. each. Their use is proposed for mirrors, clock-cases, etc.

VALUE OF BASIC SLAG AS MANURE.—The *Newcastle Weekly Chronicle* quotes the results of Dr. Wagner's recent experiments on the value of phosphatic manures. Most favourable returns have been obtained with the "basic slag" of the Thomas and Gilchrist process. It was found to be a better and more economical manure than guano, bone-meal, or coprolites. Two units of phosphoric acid in the form of powdered slag, which cost from 3s. 6d. to 4s. 6d., gave as good results as one unit in the form of superphosphate, costing 4s. to 5s. It is peculiarly suitable for clover, grass, and lucerne, and acts well on moorlands, peaty, medium, and sandy soils.

INCA REMAINS.—The British Consul at Mollendo, in Peru, in his last report, states that a limited liability

company has lately been formed there, with a capital of about £8,000, called the Campañia Anonima Exploradera de las Hucas del Inca, with the object of searching for antiquities and valuables in the old Inca burial-grounds in the district of Cuzco, a concession having been granted to the company by the Government for this purpose. The Consul says there is no doubt that many valuable curiosities, and probably deposits of gold and silver, exist in these ancient tombs, but it remains to be seen whether they will pay the cost and trouble of finding.

The Proposed German South Pole Expedition.—Mr. Henry Villard has addressed a letter, dated the 4th inst., from Karlsbad, to the *National Zeitung*, in which he ascribes the merit of having planned a German South Pole Expedition to his fellow countryman, Mr. Neumayer, director of the Marine Observatory at Hamburg. Mr. Villard states that he offered to assist Mr. Neumayer in his project, and that in the efforts he has made in the matter he has met with a cordial response from all parts of Germany. For the present, the writer adds, he is only dealing with a mere project, but should the affair end in the expedition being organised, the conducting of it should be entrusted to the originator of the scheme, Mr. Neumayer, who, as a man of science and a practical seaman, is so eminently fitted for the task.

Darkening a Lecture-room.—The lecture-room in the physical laboratory at Cornell University is provided with a novel means of darkening it, for the purpose of projecting views on a screen, or for any experiment requiring a dark room. The shutters to the windows are suspended on cords which pass over pulleys, and are joined to a single weight in the basement sufficient to balance all the shutters. A long cylinder situated under the weight is connected with the water supply, and the piston rod raises the weight whenever the water is admitted into the cylinder; the falling of the weight closes the window shutters. This apparatus is managed by a small lever at the reading stand at the desk on the platform, so that the lecturer can, without any unusual effort, either lighten or darken the room according to the immediate needs of his lecture.

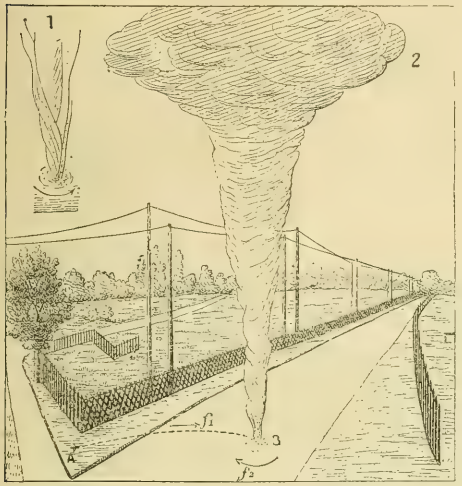
The Ladies' Conversazione at the Royal Society.—The second annual conversazione was held in the room of the Royal Society on June 6th, and in response to the invitation of the President and Council a brilliant and distinguished company assembled. Many of the objects shown have been already described in our account of the first meeting (see page 470). In addition there was a fine display of rare game birds from Central Asia, exhibited by Mr. Henry Seebohm; they were mostly of the pheasant, grouse, and partridge class. Sir Frederick Bramwell sent an ingenious revolving apparatus designed to show at a glance the varying effect of colour produced by combining different proportions of other colours. Mr. Crookes exhibited specimens of auriferous quartz, auriferous blende, and other gold-bearing minerals, from Mr. Pritchard Morgan's mine near Dolgelly, as well as an ingot weighing 1 cwt. 33 lbs. Mr. Burns showed various kinds of ants, living and moving in their beautifully constructed nests. In one cell was a queen, with her servants ministering to her wants; in another were aphides, or the ant-cows, with their keepers. One nest contained a party of workers busily employed in building up an intruding queen, which Mr. Burns had placed among them in the morning. One ant shown threatens, according to Sir J. Lubbock, to extinguish all other British species. Some of Mrs. Watts Hughes's voice figures—*i.e.*, figures and photographs of figures produced by the voice acting upon an elastic membrane used as a vibrating disc by placing on it either liquid, paste, or powder, were very beautiful. Some of the figures are strikingly like those of natural flowers, ferns, trees, etc. The only fresh-water medusa known—a jelly fish found in the Victoria Regia tank in the Botanic Gardens some years ago, and which has appeared every year since—was shown by Professor Ray Lankester, and its lively gambols attracted many admirers. In the library Mr. Walter Gardner exhibited a great number of slides showing the vast variety of methods whereby plants are enabled to maintain their place and spread themselves abroad in the struggle for existence.

Phosphorescence and Ozone.—From a scientific point of view Professor Dewar's admirable lecture at the Royal Institution, last Friday evening, was an agreeable change from some of those given during the session which has just been brought to a close. For more than a year he and Professor Liveing have been seeking the cause of the phosphorescent light produced in a vacuum when an electric discharge passes through it, and the chief object of the lecture was to show and explain a series of experiments by which it can be proved that the phenomenon is due to the presence of ozone. We are all familiar with the beautiful colour effects produced by passing an electric current through Giesler and other well-known vacuum tubes, and Professor Dewar showed that these effects are due to the phosphorescence of gases remaining inside the tubes, and not to any phosphorescence of the glass. This he proved in the following manner:—He exhausted a glass cylinder about three feet long and about six inches in diameter, and on passing a strong electric current through the cylinder no luminous effect was produced until he introduced a jet of air. A thin luminous beam was then visible along the axis of the cylinder, and it was remarkable that at no time was there any light near the sides of the cylinder. It was always confined to the middle. On admitting hydrogen into the cylinder the luminous beam was completely destroyed, and on turning off the hydrogen and again admitting air there was the characteristic stre as before. When carbonic acid gas was introduced the luminous beam became shorter but fairly bright, and the lecturer explained that this effect was doubtless caused by the production of ozone on some of the carbonic acid being decomposed. When nitrous oxide was tried the beam was brighter than in any of the other experiments, the light being strong enough to read by in a dark room. Then to manifest the presence of ozone, Professor Dewar placed a piece of starch paper on a glass inside the cylinder, and on repeating the experiment with air, in a few seconds a patch of dark blue about one inch in diameter was formed about the middle of the paper. This was due to the well-known reaction of ozone on the iodide of potassium, the iodine being liberated and a blue mark being left on the starch paper. We hope shortly to give a report of this interesting lecture, and we commend its perusal to all who care to follow these important investigations.

WHIRLWINDS.

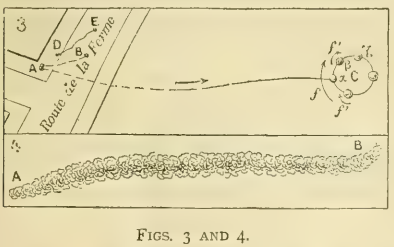
M. H. GILBERT, Professor at the Colbert Municipal School, has been fortunate enough to observe near at hand a whirlwind or "land-spout," and he has sent an account of the phenomenon to *La Nature*, accompanied by very good sketches, which we have obtained permission to reproduce.

On Sunday, May 13th of the present year, about



FIGS. 1 AND 2.

half-past three in the afternoon, the author was walking with some members of his family on the field of manœuvres at Vincennes, along the so-called Route de la Pyramide, at the junction of the roads leading to the farm and the pheasantry. The heat was overpowering (here in England it was the first genial day of the season), the sky very pure, and the air absolutely calm.



FIGS. 3 AND 4.

On arriving at five or six metres from the spot marked A on the sketch (Figs. 1 and 2), he heard a strange and very distinct sound, like that which would be made by spinning a colossal top. This was the more strange as there was no apparent cause; the atmosphere remained clear and calm, and the country, which is quite flat, presented nothing uncommon. He now perceived at A a rotatory movement of great violence; the road is very dusty, and the dust and fragments of all sorts seemed carried along in a very rapid revolving movement (Fig. 1). The whirlwind then took a definite form, that of a large funnel placed in its ordinary position. The sand carried along by the rotatory movement expanded by degrees as it ascended on the circumference of the whirlwind.

The apparent size of the "land-spout" increased rapidly by the constant afflux of dust, which finally collected at the height of 20 or 25 metres, forming an opaque cloud of a globular form.

But the whirlwind, including the globular cloud, was also actuated by a general movement of translation, far more slow than the rotatory motion. The column moved as a whole without becoming bent, which may be due to the perfect stillness of the atmosphere, or to the slowness of the translatory movement.

The first dust column, represented by Fig. 2, lasted at most for three or four minutes. On arriving at B the point began to oscillate in a vertical direction, to dance, if we may use the expression. Finally it rose up from the ground, and the whole disappeared. At the upper part there remained nothing but a vague cloudiness which quickly vanished. In Fig. 2 the arrow f 1 gives the direction of the translatory movement; f 2 shows the direction of rotation.

A few moments afterwards a second point began to appear at D (Fig. 3), a column was formed smaller than the former, and travelled quickly along the track D E, but its career was very brief. This was not the case with the third and last column, which took its rise nearly at the same spot A, and recommenced a series of movements similar to those already described. The globular cloud was less distinctly visible. The phenomenon, however, was more durable; it described a path, A C (Fig. 3) of at least 100 metres in length, and presented towards the end of its career—five or six minutes—a remarkable segmentation. On arriving at C the point began to dance; then, suddenly, it gave place to five or six smaller points, which arranged themselves in a circle of some metres in diameter. Each of these points revolved upon itself in the same direction as the original point. Further, they were all animated with a circular movement along the circumference on which they are distributed. The general rectilinear movement of translation had ceased. After a few seconds the points grew weaker, danced, rose up, and disappeared.

The author attempted to ascertain approximately the temperature of the ground where these phenomena first made their appearance. He applied the back of his hand to the ground and felt a slight sensation of cold. He then examined the furrow (A B, Fig. 4) traced by the point of the first whirlwind or dust-spout. The soil seemed confusedly hollowed for a uniform breadth of a few centimetres, and sharply defined. But beyond this furrow there was no trace of any converging movement of the dust such as might result from an inrush towards the axis of the whirlwind. Lastly, it is said that the general state of the atmosphere and its equilibrium did not seem affected by these phenomena.

We must, however, not forget that a few hours later there occurred, in the South of England at least, a sudden atmospheric change. On Sunday, May 13th, the weather near London had been much like that experienced at Vincennes. Early in the morning of Monday, 14th, the wind turned to the north-east with a great fall in the temperature. *La Nature* regrets that M. Gilbert did not approach the column and try to feel if there was any ascending or descending current of air.

THE COLOURS OF TWILIGHT.

PROF. CONSTANTINI ROVELLI has recently published, in the *Revue Scientifique Industrielle*, a study upon the colours exhibited at twilight, according to the state of the air.

Red and orange tints predominate when the air is dry. On the contrary, yellow, and especially green, characterises air charged with vesicular vapour.

Prof. Rovelli studies the colourations of the air and their successive modifications in various cases and in the various parts of the crepuscular region in measure as the sun disappears from the horizon. He likewise studies the same phenomena at the advent of "aurora with rosy fingers," and from them draws conclusions based upon the theory of the colours of the solar spectrum. Observation has already shown that the warmest colours of the spectrum predominate during a period of fine weather, while a yellow tint, followed by a greenish twilight, is the index of great humidity.

On another hand, we may consider the atmosphere as formed of two strata, the lower of which contains clouds and dust, and the upper of which is more transparent. These two strata, as regards their refrangibility and absorption, behave differently in the presence of the rays that traverse them. From this Prof. Rovelli concludes that the crepuscular green is the precursor of rain, and, on the contrary, that a rosy twilight announces fine weather, according to the saying, "Rosso di sera; buon tempo spera." Let us compare with this adage the one current in Provence: "Roudgé dé matin, ploou sü lou vesin"—*i.e.*, "red in the morning, rain is approaching."

BLUE MILK.

THE "blue milk" in question is not that well-known fluid retailed by some milkmen, and owing its heavenly tint to a careful removal of the cream and a liberal addition of water. The *Gazette Agricole* describes a morbid change which sometimes occurs in unadulterated milk under conditions not fully determined. Such milks display sometimes a yellow colour, sometimes a red, but most frequently a blue, owing apparently to the presence of a multitude of living beings. When first drawn the milk has nothing peculiar in its appearance. But after exposure to the air for about twelve hours there appear round blue spots of different sizes which gradually extend. The blue colouration of milk sometimes becomes a very serious evil, not confined to single farms, but extending over entire districts, as it has been observed in Normandy, Artois, Holstein, and elsewhere. This affection is most common from the beginning of summer to the end of autumn. Such milk is not merely disgusting, but actually injurious, especially to children.

The causes which foster the appearance of this mould in milk are not fully known. Phthisical cows, ill-cared for and fed on spoiled food, are more liable to this alteration in their milk than such as are healthy and well treated.

The dirtiness of cowhouses, dairies, and milkpails further promote the infection. It is certain that if the blueness of milk is due to a fungus all these conditions must aid in its multiplication. However, it appears to be demonstrated that "blue milk" is closely connected with a diseased state of the cow.

It is probable, though not fully established, that it is a cryptogamic infection of the udder.

INEQUALITIES OF MEN.

M. LAPOUGE, of Montpelier, has recently delivered before the Faculty of Natural Sciences in that town a series of lectures on inequalities among men, in the course of which he said that the political dogma of equality rests on hypotheses which are utterly false. He distinguished four social types among mankind:—(1) The initiators, who show mankind the way into the region of the unknown, and who go in front. Restless and daring, with an intelligence which is at least equal to the average, men of this type do not travel readily along beaten tracks. New ideas are the breath of life to them. They spend their lives in new creations; they are often wrecked, but the true genius represents the most perfect form of this type. (2) Men of spirit, of intelligence, who, possessing no creative power themselves, yet carry out and perfect the ideas and discoveries of the first type, to which they are really the complement. (3) Men who, with much or little intelligence, can work only with others, who mistrust every new idea not accepted by all the others, but who seize it with avidity when their neighbours adopt it. If intelligent these men are docile, but they dislike every change in routine, and they represent the dulness of the mass in the face of every reform. (4) Men of this type are not fit to attain even the smallest step in culture. Evidently every man cannot be classed under one or other of these divisions. In human societies clear lines of demarcation do not exist, but for general purposes the distinction is sufficiently evident. The superiority of a race or nation depends on the greater or smaller number of men of the first two classes. The race which is richest in the first type is the blonde dolichocephalic, and this has been the case even when the people among whom they lived were not of this kind. In Egypt, Chaldea, Assyria, Persia, India, and even in China men of this type ruled. In the Greek and Roman world it was the same, and it is so still. In our own day the rank of a nation corresponds with the strength of the blonde dolichocephalic element. The Gallic and Frank elements which made France great were of this type, and it plays the same part in England, Germany, and America. Near these come the Semitic and Mediterranean races, who had reached a high grade of civilisation when the blonde dolichocephalic peoples were still savages. The remainder of mankind must be reckoned the passive races. The brachycephalic races of Europe, the Celto-Slavs, rarely produce men of the first intellectual type. In the social changes of recent years brachycephalic men, who form the lower classes, have been elevated and brought forward, and herein, the lecturer thought, lies the great danger of the future deterioration of the French nation. The existence of the superior blonde dolichocephalic type is threatened by amalgamation with the dark brachycephalic and inferior races.

HEIGHT OF AEROLITES AND SHOOTING STARS.—According to M. Denning (*Astronomie*), the mean heights observed for the latter class of bodies were 129 kilometres at the beginning of their course, 108 in the middle, and 87 at the end. The aerolites are at lower altitudes, respectively, 111, 79, and 48 kilometres. He calculates accordingly that the shooting stars become ignited in the earth's atmosphere, at a height greater than that of the aerolites by 18,000 metres.

Natural History.

YOUNG TAPIR IN THE ZOOLOGICAL GARDEN AT COLOGNE.

On Sunday morning, August 6th, of last year, a tapir was born in the Zoological Garden at Cologne, and when I had time to examine it in its stall, I found it a most beautiful little animal. There was not that lack of proportion between its body and legs which is always so noticeable in the young of the deer and the antelope. Its form resembling very closely that of the grown animals, although the colours of its coat were very different from theirs. Instead of the thin bristle-like covering of the old ones, through which the skin shows, it had a thick, velvety, shining black fur, from which the yellowish-white stripes and spots stood out beautifully. Along its spine ran a row of spots, and parallel with these, on the sides of the body, were many long stripes, one below the other, which terminated on the haunches in short oblique lines. Between these lines were more spots, which were so close together on the belly and on the legs, near the pretty little hoofs, that these parts of the body looked really speckled.

His prettily coloured coat made the young tapir look very different from his parents, with their uniform dark

colour, but, on the other hand, gave him so strong a resemblance to the young of the wild hog, which has the same marking on a light ground, as to furnish the careful observer with matter for thought, specially as science does not confirm the suggestion of a very close relationship between the tapir and the swine. The latest arrangement places them in two very different classes of mammals. In explanation of this apparent contradiction it should be said here that the present members of the two orders, which are distinguished by the formation of the feet, are only the remnants of the numerous groups of ungulate animals which existed in the earlier ages, and are uninterruptedly connected by the species which have died out. The habits of the tapir in the care of her young are the same as those of the sow, the young tapir sucking just as the little pig does, while the mother lies on her side. Our artist has given us a very natural representation of the young tapir with his parent.

Our young tapir thrives under the care of his strong, well-fed mother, and at a remarkably early age he gave proof of his independence. Before he was a week old he began to eat with old ones, adopting their quiet, thoughtful manner, to the delight of the public, when tasting the bran, or slowly chewing a little clover hay, as if trying it. As he grew, there was a perceptible change in his appearance. In the fourth week his coat began to thin out, so that the skin showed through it here and there, and as the background became lighter, the spots became quite indistinct, and then entirely disappeared. As nearly as I could tell, the change was caused by the light hair of the spots dropping out, and dark hair taking its place. According to Renggar, the light marks will entirely disappear in the third year. I trust that we shall be able to test his assertion with our young tapir, and his well-rounded body and gay movements at twilight seem to give foundation for my hopes.—*Illustrirte Zeitung.*

PALLAS'S SAND GROUSE.

The numbers of Pallas's sand-grouse (*Syrrhaptes paradoxus*) which are now visiting this country are far greater than might be supposed from the few instances already recorded in our columns, and it is greatly to be regretted that the same stupid slaughter of these curious birds which was carried on during the great visitation of 1863 should now be persisted in. Those ornithologists who wish to protect the strangers will do best by not revealing, at least for the present, the localities they affect, as thereby the attention of those who cater for that pestilent person the "collector of British birds" is attracted, and the birds are shot. The German Government, it is said, has taken steps to prohibit the destruction of sand-grouse, and the probability is that they will in consequence establish themselves in many of the sandy tracts of the Empire, breeding there as they did in Denmark and in Holland in 1863. Unfortunately no such prohibition is possible in the British Islands; but landed proprietors might afford protection quite as effectual by ordering their gamekeepers not only to spare the birds they may see, but also to forbid pursuit on the part of others. For this purpose the Wild Birds' Protection Act gives them authority, and, ridiculous though its penalties are, compared with the market value of the spoil, sufficient inconvenience may be caused to those who contravene its provisions to make them cautious, while the arm of the law might even reach the "collector," on whose behalf the slaughter is committed. The historian of the irruption of 1863 spoke in strong terms of the utter disgust with which he regarded the wanton massacre which was then perpetrated, and of how it had made the collecting and arranging of materials for his account, which, though a laborious, would have been otherwise a congenial task, from beginning to end irksome to him; and equally irksome from the same reason, it is to be feared, will be the task of him who has to compile an account of the present visitation, for hitherto from Kent to Aberdeenshire comes the same cruel story of blood.—*Times.*

A living specimen of Pallas's sand-grouse (*syrrhaptes paradoxus*), the new visitor from Central Asia, has been presented to the Zoological Society by Mr. H. Hewat Crane, of West Foulden, Berwick-on-Tweed. It was captured at that place on May 25th.

The Smallest Plant in the World.—The smallest flowering plant in existence is *Wolffia microscopica*, a native of India. It belongs to the natural order Lemnaceæ, or the duckweed family. It is almost microscopic in size, destitute of proper stem, leaves and roots, but having these organs merged in one, forming a frond. There is, however, a prolongation of the lower surface into a kind of rhizoid, the purpose of which seems to be to enable the plant to float upright in the water. The fronds multiply asexually by sending out other fronds from a basilar slit, or concavity, and with such rapidity does this take place that a few days often suffice to produce from a few individuals enough similar ones to cover many square rods of pond surface with the minute green granules. But small as these plants are, and simple in their structure, they yet produce flowers. Two flowers are produced on a plant, each of them very simple, one consisting of a single stamen, and the other of a single pistil, both of which burst through the upper surface of the frond. There are two species of this genus growing in the Eastern United States, one of them, *Wolffia Columbiana*, about 1-25th of an inch in diameter, and the other, W. Brasiliensis, somewhat smaller in size. The American species has been collected near Philadelphia.—*Scientific American.*

Reproduction of Parts of Plants.—Prof. F. W. C. Areschony explains, in the *Botanisches Centralblatt*, the tendency of some parts of plants to produce leaf-buds and stems, and of others to produce roots, or, of the same parts, sometimes to produce leaf-buds, at other times roots, by the hypothesis that leaf-buds are produced by those parts where there is a larger accumulation of nutrient material, roots by those parts where the supply is smaller, stems requiring a larger amount of nutriment than roots in consequence of their larger size and greater complexity of structure. This is illustrated by the well-known fact that in trees the strongest branches always spring, not from the lower, but from the upper part of the previous year's shoot, where there is a larger supply of nutriment. Again, leaves in which the supply of food material is limited can, as a rule, produce adventitious roots only; but occasionally leaf-buds on their basal portion.

The Maize Caterpillar.—According to M. Laboulbène the crops of maize in France are being seriously damaged by the caterpillar of a small moth, *Botys Nubilalis*. It attacks the interior of the stalks, and rarely

interferes with the ear. The same insect is also injurious to hops, hemp, and millet.

INSECTS AS HUMAN FOOD.—According to Mr. A. S. Olliff, F.E.S., of the Australian Museum, Sydney (*Entomologist*), the larvæ of various moths, such as *Zelotypia*, *Hepialus*, *Charagia*, *Pielus*, as well as those of certain Coleoptera, especially long-horns and weesils, are eaten not merely by the aboriginal blacks, but by some of the British settlers.

CULTURE OF TROUT IN PONDS.—M. Zipoy (*Journal d'Agriculture* and *Cosmos*) shows that lake trout may be successfully bred in ponds. The water must be fairly cool, and of course unpolluted, and it should be constantly renewed by a considerable inflow and outflow. The bottom should be sandy. Animal food, such as that recommended in SCIENTIFIC NEWS, p. 468, will be found the most suitable.

BIRD-DOINGS OF THE SEASON.—Mr. H. Kerr (*Newcastle Weekly Chronicle*) mentions two interesting facts. The first is the increasing prevalence of the swift in and near Manchester, a region which would seem to have few attractions for birds, and where the species has hitherto been far from numerous. The second is the convictive evidence found as regards the egg-eating propensities of the rook. Near Kelso more than half the nests of the small birds have been robbed by these greedy pilferers. We may ask whether the lateness of the season has driven the rooks to make an extraordinary use of this food.

IMPORTATION OF BIRDS INTO OREGON.—We learn that 700 European singing birds are to be imported into Oregon by a society of German colonists, who deplore the absence of songsters in the Great West. Skylarks, bullfinches, nightingales, chaffinches, goldfinches, linnets, greenfinches, thrushes, and starlings will form the cargo, and will be let loose in the country immediately on arrival. We trust, however, that these birds will not ultimately prove so great a nuisance as the rabbit and the thistle have in Australia.

AN ANTI-EVOLUTIONIST ARGUMENT.—"Show me," says M. Blanchard, in his recent work, "La Vie des Etres Animés," "a single instance of the transformation of a species!" "Show us," we reply, "a single animal or plant produced in any other way than from a pre-existing animal or plant!"

THE HOODED CROW.—According to correspondents of the *Newcastle Weekly Chronicle* the hooded or Royston crow (*Corvus cornix*) and the ordinary carrion crow (*Corvus corone*) breed together in England and Scotland. Being, however, very much less plentiful in Britain than in Siberia, such cases are less frequently observed here than in the latter country.

THE WEST INDIAN FIRE-FLY.—A specimen of this beetle (*Pyrophorus noctilucus*) has been brought over in full vigour by Dr. Brand, of Hanley Road. Two organs at the base of the thorax emit a beautiful greenish light, and two others, on the abdomen, an orange-coloured light. The luminosity is evidently under the control of the insect, and becomes more intense if it is irritated. The light is strong enough to render the faces of persons recognisable in a small darkened room.

THE TEACHING OF GEOGRAPHY.

GEOGRAPHY as a school subject can never lose its place. It is at once so interesting and so important that boy and man alike love to get it up. Only the very worst teaching, pedantic and unreal, can spoil so delightful a study. There are, it is true, text-books of geography competent to this difficult feat, books in which names and statistics are deliberately preferred to facts and reasoning, but most of us are better treated, and it is with more or less pleasure that we gather from our books and teachers some new glimpses of the great world and its inhabitants.

The sound teacher is ever trying to get out of his subject more drill for the minds of his boys. Mere facts may not give opportunity for this drill, but facts which can readily be reduced to laws, do. Physical geography, or physiography, for example does. This side of geographical teaching has been methodised by Professor Huxley and others, and there is now no excuse for teaching it by rote. Those who wish to find exercise for the minds of smart and fairly well-trained schoolboys will find it in Alfred Hughes' "Practical Geography for Schools," recently issued by the Clarendon Press, an admirable collection of exercises on the simpler laws which can be deduced from such natural phenomena as the seasons, day and night, and other semi-astronomical data. Such work must never be taken too lightly, unless we would have our young people grow up as "semi-Solomons, half knowing everything from the cedar to the hyssop."

Where geography comes to deal with concrete facts, reducible to no laws which the mind, at least of a schoolboy, can grasp, it becomes incapable of furnishing good material for mental gymnastic. But the interest and practical importance of the facts save them from the possibility of being neglected. What are the natural productions of different countries, what snowy mountains and active volcanoes are like, what sort of people inhabit the forests of Brazil, and the deserts of Africa, and the frozen wastes of Greenland, the active-minded boy must needs know. If you don't tell him at school he will make what he can out of "Robinson Crusoe" and "King Solomon's Mines." And the boy's father, trading perhaps with distant countries himself, will by no means be satisfied to have the lad grow up ignorant of India and the Colonies, and what they produce. Whatever the schoolmaster may think of commercial geography, he must bring it in, and it will be wise to teach it carefully and well.

How capitally the Dutch do this! A young fellow going out to Java, or a merchant trading with the East Indies, can get to see for himself the productions, the dress, the houses, and ten thousand other details of any of the Dutch possessions, and all without leaving his own town or city. Collections of every kind, photographs, and printed matter, are accumulated at vast expense for this express purpose. But the young Englishman going out to India, the English merchant trading with Bombay or Fiji, has no such facilities as his Dutch competitor. He may collect photographs and books, and make a museum for himself if he pleases. There is nothing ready to his hand, except the Indian collections at South Kensington.

Our recent Colonial Exhibition was far from useless in its way. Would that some part of it had been made permanent! Perhaps the new Technical Institute may fill the gap to some extent. But England is too wide

to be served by any one collection. The idea at least of such collections, and the more obvious of their lessons, must be brought home to the many who do not commonly visit London.

It is coming down to a very homely topic when we pass from great national collections, and geographical schools, such as those of Leyden and Amsterdam, to the school museum of geography. But the school museum which should be ever at hand, and can be interpreted by the teacher to a very young mind, is an educational resource of no mean value. True it is that the teacher may talk sensibly about indigo and cochineal without producing specimens, but his teaching will be all the better if he is able to show the leafy indigo-plant, and the dried bodies of the cochineal insect, and thus fix permanently in the minds of his pupils that the one is a vegetable, and the other an animal dye. The habit of going down to the bottom of a question, and never taking the word for the completely understood fact, nor the so-called fact for the thing, where any possibility of getting nearer to the tangible phenomenon exists, is yet more valuable. A collection in which visible and tangible impressions can be looked up, just as meanings of words are looked up in a dictionary, would give new thoroughness to those branches of geography, such as commercial and historical geography, which are depreciated, and not altogether without justice, as essentially non-disciplinary.

To carry out our own maxim that teaching without example profits little, we go on to suggest certain groups of objects which might be really useful in a geographical museum.

Geographical Museum.

A. Physical Geography.—Moving models to illustrate day and night, seasons, etc.; relief maps of the district; specimens of lava, granite, gneiss, marble, sandstone, limestone, chalk, shale. (N.B. the rock collection may easily be made too large.) Models of river-delta, volcanic cone (section), etc.

B. Ethnology.—Photographs of houses, useful arts, etc., photographs of various races of men; flint implements, polished stone implements, rude pottery, etc.; model of Swiss lake-dwellings; model of Sumatran house; querns, rice-mortar, sago-crusher, strainer, etc.; stick plough, primitive spades, etc.; photographs of ornament, carved work, architecture of India, Burmah, etc.; stamped Egyptian brick, objects from mummy cases.

C. Commercial Geography.—Food-plants, especially cereals (ears and grain), tea, coffee, cocoa, etc.; dye-plants (indigo, sumach, etc.); animal dyes (cochineal, lac, kermes); timber, specimens of a few important timber trees, with leaves, bark, and wood; shellac, stick-lac, lacquered objects, insect-wax of China; useful ores (hæmatite, copper pyrites, cinnabar, etc.); vegetable textile fibres, and the plants which yield them (hemp, flax, jute, cotton, etc.); animal textile fibres (wool, mohair, etc.); important drugs, and the plants which yield them.

D. Historical Geography.—Photographs of historic sites, interesting buildings, etc.; relief maps of the neighbourhood of Rome, Athens, Syracuse, etc.; maps of Roman Britain, etc.

It will of course be understood that these are mere hints. A complete catalogue of useful objects would take up far more space than we can afford.

What we have dignified with the rather too important name of museum may well be lodged in one or more cupboards with glass doors. The vegetable and animal products, and all else that admits of it, should be kept in wide-mouthed glass bottles of uniform size and style. The photographs should on no account be mounted, as they then become perishable, owing to fermentation in the paste or size. It is far better to stretch them behind glass, back them with dry mounts, and then bind the edges. A rack will hold great numbers of such frames with economy of space, and if the visible edge of each is lettered, there is no trouble in picking out any one that is required.

ON DEATH BY THE ELECTRIC CURRENT.

E. J. HOUSTON, in the *Proceedings of the American Philosophical Society*, remarks that several cases of death have resulted from incautious or accidental touching or handling of the wires employed in carrying the currents used in electric lighting. It becomes, therefore, a matter of great importance to inquire into some of the peculiarities of such accidents.

In the case of the direct current, death results sometimes from shock, but generally from an electrolytic effect on the blood or other tissues of the body. The gaseous products arising from the decomposition possibly may be carried by the blood to the heart and thus stop its action, or death may result from electrolytic changes produced in the blood itself or in other tissues. Death by the alternating current probably results from shock only. Resuscitation in cases of apparent death are more frequent with the alternating current than with the direct, most probably from the absence of actual decomposition of the tissues.

Considerable surprise has often been manifested because certain currents that, in some instances, have been handled with impunity, in other cases have caused death.

The explanation would appear to be found in the portions of the body at which the current enters and passes out, which would, of course, necessarily be influenced by the position of the person receiving the discharge. Nearly all fatal or severe shocks occur from the lines being accidentally grounded at some point. The person then either deliberately touches, or is accidentally brought into contact with the line at some other point. Under these conditions, the electricity either passes into or out of the body at the feet. The greater or less probability of serious results will depend on the parts of the body through which the current passes. When any part of the body is placed in the path of an electric discharge, more of the discharge will pass through the better conductors, which perhaps will be the great nerve trunks and the muscles. Reference must, therefore, be had to the position of such nerve centres, as well as to the heart, the lungs and the viscera, and other vital organs. The following contacts are among the most common :—

(1) At the head. This contact is apt to be among the most dangerous, as the discharge in all probability takes place through some of the vital organs, such as the brain, the upper part of the spinal cord, or through some of the organs in the abdominal cavity or their principal nerves.

(2) At the shoulders. This is probably somewhat less dangerous than the preceding, as the brain is not in the path of the direct discharge. The vicinity of the upper part of the spinal cord is, however, very dangerous.

(3) At one of the hands. If the person is standing on both feet, this may be fatal, since the organs of the abdominal cavity and its nerve centres are in the path of the discharge. If the person is standing on one foot, then if this foot be on the same side of the body as the hand that is touched, the discharge will probably not be fatal, since the discharge does not necessarily pass through the organs of the abdominal cavity. If, however, the foot on which the person is standing be on the other side of the body from the hand that touches the wire—that is, if the person be standing on the right foot and touches the wire with his left hand—the discharge, if powerful, is apt to be fatal, since the organs of the abdominal cavity and its nerves are necessarily in the path of the discharge.

(4) On the back, especially in the upper portion. This is apt to be fatal, since the spinal cord is dangerously near the path of the discharge. The muscles of the back are also very large, and would thus determine the passage of much of the current in this direction.

(5) Discharges ensuing on touching the wires with each hand are apt to be fatal, since the heart lies in the path of the current.

Those exposed to electric discharges would be protected from the effects of accidental grounding of the conductors by wearing plates or discs of any high insulating material on the soles of the shoes or inside the same.

Death by lightning probably results from the effects of shock, combined with those of electrolysis. In discharges of such enormous difference of potential as exists in lightning, disruptive effects may also be produced.

The almost instantaneous and consequently painless nature of death by the electric shock has led to the suggestion that it be employed in public executions in place of hanging or decapitation. Should such suggestion be adopted, the character of the apparatus employed should be such as to cause death by shock, followed, to avoid the possibility of resuscitation, in case of apparent death, by the passage of an electrolysing current.

Reviews.

Watts' Dictionary of Chemistry. Revised and entirely re-written by H. Foster Morley, M.A., D.Sc., and M. M. Pattison Muir, M.A. Vol. I. London: Longmans, Green, and Co., 1888.

The advance of chemistry as a science has during the last few years been so enormous that the first edition of this dictionary, which was begun a quarter of a century ago and finished by the last supplement in 1881, is quite out of date. Organic chemistry especially has made strides which may rightly be called gigantic, the number of organic compounds now known having doubled since Watts first brought out his record. The work was then called "A Dictionary of Chemistry and the Allied Branches of Other Sciences," but the great development of both chemistry and chemical technology has rendered necessary, or at least advisable, a restriction of the dictionary to the subject of chemistry proper; while technology is to be treated separately in a companion volume by Professor Thorpe. Notwithstanding this subdivision, an ingenious though easily understood system of condensation and abbreviation has been found needful in dealing with organic compounds. Special articles have been contributed by eminent men, and among them we note as particularly worthy of the attention of our readers the article on "Blood" by Dr. Halliburton, that on "Bacteria" by Professor Ray Lankester, and Professor Ostwald's article on "Affinity," translated by Miss Ida Freund, of Newnham College. Professor Meyer contributes an interesting and suggestive essay on "Allotropy," and Professor Thorpe a valuable one on "Atmosphere." Dr. Stevenson's comprehensive and accurate account of the state of present knowledge on the subject of poisonous alkaloids is worthy of his high reputation as a toxicologist, and gives a vast amount of information in a small space. In Dr. Halliburton's article the sketch of the growth of discovery and speculation in the matter of coagulation of blood is remarkable for his having condensed into about one column history often spread over many pages, and this without the omission of a single important fact or valuable reflection. He gives us, too, the very latest news on the subject—Wooldridge's highly important observations on the influence of the lecithin contained in the substance known as fibrinogen A. Dr. Halliburton's own researches in reference to the blood of the invertebrates are so valuable that they lend a special interest to this article on the subject by his own hand. The scope and progress of the new branch of biological science known as "bacteriology" will be appreciated by readers of Professor Lankester's account of the bacteria, with useful bibliography attached. Its influence upon general medicine and surgery, though probably still in its infancy, is attested by the amount of attention now being given to it all over the world by pathologists, and its value in furthering the development of preventive medicine—that great hope of the future—is foreshadowed by the work of Pasteur. The fact that Professor Lankester dismisses the subject of "Abiogenesis" in a few lines is indicative of the thoroughness with which Professor Tyndall pulverised the theory of Dr. Bastian—a theory which is now chiefly of historical interest.

The article on "Atmosphere" will be liked by nearly all classes of our readers; the subject facilitates a treatment at once full and accurate, technical, and comprehensible by the ordinary man of intelligence; and Professor Thorpe has wisely taken advantage of his opportunity.

To the advanced student of chemistry the more strictly chemical part of the book will afford a mine of wealth; we refrain from more than general commendation in this respect, as the subject is so entirely one for the real student, and he would hardly thank us for a particular account, while the general reader would assuredly neglect it altogether.

We have only one fault to find with the book, and in the face of such general excellence we are almost ashamed to mention it: in spite of the explanation of the editors, we cannot help regretting the absence of details of analytical processes, for we feel sure they will be greatly missed, and will prevent that sense of effectual completeness which would otherwise be given by this fine work.

The Geology of England and Wales. With Notes of the Physical Features of the Country. By Horace B. Woodward, F.G.S., of the Geological Survey of England and Wales. London: G. Phillips and Son.

This volume is a second and much enlarged edition of a work published by the author some ten years ago, and as a book of reference is of high value; differing as it does from the ordinary text-books of geology, in that it enumerates the principal geological facts of the country,

together with an account of the lithological characters and economic products of the stratified rocks, rather than giving a knowledge of the elements and principles of the science as a whole.

At the commencement we have a woodcut of the geologist cheerfully tramping along a road, with his hammer and specimen bag over his shoulder, his pipe between his teeth, and his dog bounding merrily at his heels, and for a finis the same gentleman is depicted seated at a desk completing the record of his labours, attenuated it is true, but evidently joyful; the dog, alas! is dead, but we confess we were neither overcome like the dog, nor overjoyed like his master at coming to the end of the book, as the only point we have to complain about is the insertion of sundry woodcuts, which appear rather out of place in a serious book of reference.

Not the least useful part of the book is the account of the economic products inserted at the end of the descriptions of the various strata, including analyses of many of the principal rocks, mineral waters, etc. In the account of the economic products of the coal measures, there is a curious statement of the products of the distillation of 100 tons of cannel coal, attributed to Sir H. E. Roscoe, as follows :—Gas, 10,000 c. ft., or 22 tons; coke, about 60 tons; ammonia liquor, 9½ tons; tar, 8½ tons. Considering that the best cannel coal yields from 13,000 to 14,000 c. ft. *per ton*, the first item should surely be 1,300,000 or 1,400,000 ?

The minute local variations of strata and general information thereon contained in the book, are very accurately set forth, so far as we can check them from personal acquaintance with many of the districts described; and the large coloured geological map of England and Wales, is a most useful adjunct to a work of this kind.

We wonder whether geologists will ever agree to a universal system of colouring for these geological maps; at present the choice of colours to represent various strata seems purely arbitrary, and is not a little confusing. In an appendix we have a useful synopsis of the animal kingdom, with especial reference to the fossil forms, by E. T. Newton, F.G.S., F.Z.S.

An Elementary Text-Book of Practical Metallurgy. By Alfred Roland Gower, late Demonstrator in the School of Metallurgy at the Birmingham and Midland Institute. London : Chapman and Hall.

The want of a book which deals simply, systematically and judiciously with the subject of Practical Metallurgy has long been felt. The existing text-books are, for the most part, too large, or deal too exclusively with assay methods. The publication of Mr. Gower's little volume may therefore be hailed with satisfaction, as an attempt to satisfy this recognised need. 'Unfortunately, perhaps, it bears too plainly the brand of "South Kensington;" it being confessedly written for the elementary students in the classes of the Science and Art Department, the author was of course bound to follow the stereotyped syllabus of that body, with the result that his work is rather suggestive of the *cramming* which is the bane of modern educational systems. The book is divided into two parts, the first of which deals with the matter required for the elementary stage, the second with that for the advanced stage of the May Examinations; and as these requirements overlap, there is necessarily in some places a little repetition. As far as it goes the work is fairly complete; each of the subjects laid down by the Kensington authorities is dealt with carefully, and the various reactions are given at length with the accompanying calculations of quantities, and in most cases a brief explanation of principles. The only omissions of any consequence that we have observed are: the chlorination and precipitation of gold ores; and the details of furnace manipulation, upon which the sucess of an experiment so largely depends.

The author rightly insists on the advantages of a previous knowledge of chemistry; but he has presupposed a higher knowledge than is justified by our experience of the men for whom he writes. He frequently introduces terms which can be understood only by one who has worked for some time in a chemical laboratory; moreover the details of manipulation are not adequately explained for a beginner. Again, at the end of the book, among a group of useful appendices, we find one which gives indiscriminately the specific gravities of gases as referred to hydrogen, and of solids as compared with water, without any note to show which of the elements is gaseous, which solid; and another which summarises in a series of equations without comment, the principal reactions of the metals. Most of the latter (*e.g.*, $Pb + O = PbO$) are entirely unneeded by the chemist, whilst many would be utterly bewildering, if not greatly misleading, to the tyro.

We fear, indeed, that the plentiful use of equations throughout the book (a fault on the right side, we admit) may tend to leave an impression that the reactions at high temperatures are far more definite, and less dependent on the variations in general conditions, than is actually the case. The author has adopted the usual chemical notation, but we are at a loss to understand why tartar should appear on page 3 as ToHoKo. Nor can we clearly see why two equations are necessary to explain the precipitation of barium suphate from the chloride by a neutral sulphate—even if we admit the correctness of the first equation :—

$$KNaSO_4 + 2HCl = KCl + NaCl + H_2SO_4$$
$$H_2SO_4 + BaCl_2 = BaSO_4 + 2HCl.$$

Again, the electro-chemical equivalents of certain elements (*e.g.*, lead = 51·4, iron = 14) are not those usually ascribed to them. No allowance is made for the possible loss of zinc in making brasses of standard composition. Omitting these and a few other slips, as for example on p. 20, the occurrence of 140 for 150 as the molecular weight of SnS, and the resulting errors in calculation, the book has evidently been carefully prepared and revised. It is satisfactorily free from misprints, although it is somewhat unfortunate that the few which have crept in occur in critical places; thus in the only example of the method of calculating formulæ from percentage composition, As_5Fe_{12} is found instead of As_5Fe_{18}.

On the whole we commend the volume to those who intend entering for the May Examination in Practical Metallurgy, as a guide which will probably accomplish all that it professes to do—to assist the candidate to secure a "pass."

A Plea for the Sparrows.—An almost unprecedented attack of maggot has taken place in the Kentish fruit plantations, and nut and apple crops have been, in many instances, grievously damaged, if not destroyed. Planters are making vigorous efforts to fight the pest, but the grubs are so numerous that hitherto they have defeated all attempts to get rid of them. The increase of insects is said by the farmers to be due to the scarcity of sparrows, owing to the wholesale slaughter of the birds which has been carried on in the district.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on May 31st a paper on the "Conditions of Evolution of Gases from Homogeneous Liquids," by Mr. V. H. Veley, M.A., of University College, Oxford, was communicated by Mr. A. Vernon-Harcourt, F.R.S.

This paper is particularly concerned with the formation of gases resulting from chemical changes occurring within liquids. In the course of some experiments on the evolution of carbonic oxide, in which an aqueous solution of sodium formate had been poured into diluted sulphuric acid and the mixture heated to 35·5°, Mr. Harcourt noticed that certain particles of silica, present as an impurity in the salt, seemed to serve as nuclei for the evolution of the carbonic oxide. The experiment was accordingly repeated under precisely the same conditions as to mass of salt, concentration of acid, temperature, except that the particles of silica were carefully filtered off before the aqueous solution of the salt came in contact with the acid. It was thus found that a temperature of 73° was required to obtain a rate of evolution of gas equal to that of the experiment above. This result led to a series of experiments on the effect of chemically inert particles on the evolution of gases; it was found invariably that their presence increased to a very remarkable degree the rate of formation of gas, whether evolved from aqueous solutions or from salts in a state of fusion.

The phenomenon is apparently comparable to the effect produced by the addition of fine particles to a supersaturated solution of gases in water, such as ordinary soda-water. The two cases are however different; in the one case the gas is preformed and dissolved, in the other the gas is in process of formation, and in most instances is not apparently dissolved in the liquid.

It was observed in most cases that, conditions of temperature remaining the same, the gas is evolved at first slowly, then is gradually accelerated until it reaches a maximum, at which it remains constant for some time, and then diminishes at a rate proportional to the diminution of mass. The phenomenon of initial acceleration is apparently common to many cases of chemical change.

Effect of Pressure.—A sudden increase of pressure from a fraction to the whole of an atmosphere decreases, or even completely stops, the evolution of a gas from a liquid in which it is being formed; the phenomenon of initial acceleration then repeats itself. Conversely, a decrease of pressure produces a sudden increase in the evolution of gas. These effects are only temporary; there is apparently no permanent difference between the rates at a reduced and at ordinary pressures.

In the last portion of the paper the decomposition of formic acid into carbonic oxide and water is considered, condition other than temperature and masses of reacting substances being kept constant. The curve representing the course of the change in terms of mass of formic acid is shown to be hyperbolic, *i.e.*, the rate of change is thus proportional to the square of the mass of formic acid.

A note by Dr. Beevor and Professor Horsley, F.R.S., "On Some of the Motor Functions of Certain Cranial Nerves, and of the Three First Cervical Nerves in the Monkey" (*Macacus sinicus*), was especially devoted to proving the proposition that the levator muscle of the soft palate is inserted *not* by the facial (the seventh) nerve as usually supposed, but by the eleventh, the accessory to the vagus.

Sir William Turner, F.R.S., communicated a second memoir on the structure of the placenta in the lemurs, the species which he had examined on this occasion being (*Lemur xanthornystax*), the specimen having been sent to him by F. E. Beddaw, Esq., Prosector to the Zoological Society. The investigation which he had made supported the conclusions arrived at in his first memoir, viz., that in the lemurs the placenta is diffused over the greater part of the surface of the chorion, and that the uterine mucous membrane is not shed along with it. As the lemurs also possess a large sac of the allantois, they are in their placental characters as far removed from man and apes as it is possible for them to be. Hence the author concludes that they ought not to be included in the same order with the apes, but should form a special order of mammals to be called either with Milne Edward's *Lemuria*, or with Victor Caras' *Prosimii*.

ROYAL INSTITUTION.

The Friday evening lecture on June 1st was delivered by Professor Ewing. The lecturer pointed out that seismology was a science with two sides, one geological, the other mechanical. The geologist attacked the subject by at once attempting to refer earthquakes to their source in the crumbling, tearing, or slipping of strata, in volcanic eruption, in the collapse or explosion of subterranean cavities. The mechanical student of earthquakes, on the other hand, concerned himself with the character of the motion that was experienced, and with the means by which an earthquake spread from point to point by the elastic vibration of rock and soil. His first business was to find out exactly how the ground moved during an earthquake, to determine by direct measurement the amount and direction of every successive displacement, and the velocity and rate of acceleration at every instant while the shaking went on. This was the problem of seismometry, and the lecture would deal with the solution of this problem, and with some of the results which had been obtained in the measurement of earthquakes in Japan. Earthquakes happened there with a frequency sufficient to satisfy the most exacting seismologist. It had been estimated that one or another part of the empire was shaken every day, and in Tokio, where the measurements had been made, there was an earthquake, on the average, about once a week. Most early attempts to reduce the observing of earthquakes to an exact science had failed, because they were based on a wrong notion of what an earthquake was. It had been imagined that an earthquake consisted of a single isolated jerk, or of a few jerks, easily distinguishable from any minor oscillations that might accompany them. The old column seismometer, for instance, attempted to measure what was called the intensity of the shock by means of a number of columns of various diameters which stood like ninepins on a level base. It was expected that the shock would overthrow the narrower columns up to a breadth which would gauge the intensity of the disturbance, and also that the line in which they fell would show the horizontal direction of transit of the earthquake wave. In fact, however, such columns fell most capriciously when they fell at all. The reason was that in an earthquake there was no single outstanding impulse, but a confused jumble of oscillations, very numerous and very irregular, which shifted their

direction with such rapidity that a point on the earth's surface wriggled through a path like the form a loose coil of string might take if it were ravelled into a state of the utmost confusion. The mechanical problem in seismometry was to find a steady point, to suspend a body so that some point in it, at least, should not move while this complicated wriggling was going on; the steady point would then serve as a *datum* with respect to which the movement of the ground might be recorded and measured. The simple pendulum had often been suggested as a steady-point seismometer, but in the protracted series of oscillations which made up an earthquake the bob of a pendulum might, and often did, acquire so much oscillation that, far from remaining steady, it moved more than the ground itself. This was on account of its stability. To prevent the independent oscillation of the body whose inertia was to furnish a steady point, it was essential that the body should be suspended or supported astatically—in other words, so that its equilibrium would be very nearly neutral. Methods of astatic suspension for horizontal and vertical motion were described and illustrated by diagrams and models. The complete analysis of the ground's motion was effected by a seismograph, which resolved it into two horizontal and one vertical component, and recorded each of these separately, with respect to an appropriate steady point, by means of a multiplying index, on a sheet of smoked glass which was caused to revolve at a uniform rate by clockwork. The clock was started by the action of the first tremors of the earthquake on a very sensitive electric seismoscope. The record drawn on the plate gave every possible particular regarding the nature of the motion at the station where the seismograph was placed. A complete set of the apparatus, as made by the Cambridge Scientific Instrument Company, was shown in action. Professor Ewing also described and showed his duplex pendulum seismograph, which drew upon a fixed plate of smoked glass a magnified picture of the horizontal motion during an earthquake. Apparatus was shown for testing the accuracy of the instruments by means of imitation earthquakes which shook the stand of the seismograph and drew two diagrams side by side, one the seismograph's record and the other a true autograph of the motion of the stand. This test was applied to the instrument on the table, and the close agreement of the diagrams was shown by projecting them on the lantern screen. A number of autographic records of Japanese earthquakes were thrown on the screen, and their principal features were described. Some of these had been taken since the lecturer left Japan, by Mr. Sekiya, Professor of Seismology in the Imperial University, who had also constructed a model (shown by means of the lantern) to exhibit in solid form the tortuous path through which a point on the earth's surface moved during an earthquake. In general the motion began with small tremors of high frequency, which were probably transmitted by normal vibrations of the crust; these died out at an early stage in the disturbance, but usually not until transverse motions of larger amplitude and longer period had begun. The whole went on with irregular fluctuations and with a protracted and very gradual dying out of the shaking for two or three, sometimes even for ten minutes, and comprised some hundreds of movements to and fro and round fantastic loops. As a rule, the horizontal movement was much larger than the vertical. Each single movement usually occupied from half a second to two seconds. Earthquakes were quite perceptible in which the greatest extent of motion was no more than one-hundredth of an inch. In one case, on the other hand, as much as an inch and three-quarters had been registered. Even that was in an earthquake which did little damage, and there was, therefore, reason to expect that a severely destructive shock (such as had not occurred in Tokio since the present system of seismometry was developed) would show still more motion, perhaps much more. Professor Ewing concluded his lecture by exhibiting seismographic records he had recently taken on the new Tay Bridge to examine the shaking of the bridge during the passage of trains. The instrument had been placed on the southmost of the great girders, where it was expected that the vibration would be a *maximum*. The records showed that the greatest horizontal motion never exceeded one-eighth of an inch, even when a train was passing the seismograph—a fact which spoke well for the stiffness of the structure. Nevertheless, by watching the seismograph, one could see the index begin to oscillate whenever a train came on at the Dundee end of the bridge, a distance of one and one-third mile from where the instrument was standing. The movement began with longitudinal oscillations through something like one five-hundredth of an inch. When the train came a good deal nearer transverse oscillations also were recorded; and the bridge did not cease to shake till the train had passed off at the other end.

ROYAL MICROSCOPICAL SOCIETY.

At the meeting held on May 9th, Dr. C. T. Hudson, President, in the chair, Mr. Crisp exhibited a form of camera lucida by M. Dumaige, of Paris, fitted in a box with a cover, which, when closed, kept the prism and mirror free from dust. Also, by the same maker, an adapter with spiral springs, for rapidly changing objectives, and a portable microscope, in which the foot and stage were in one piece. Dr. Kibbler exhibited and described a new stand and camera which, he believed, would be found very useful for photomicrography. It had been made to his design by Mr. Bailey, his idea being that it was best not to take negatives upon a large plate but on a quarter-plate first, and afterwards to enlarge the pictures from the original negatives. The great advantage of this method was in the amount of light gained for the purpose of focussing. The quarter-plate size was also the proper one for lantern slides. The ordinary diaphragm-plate placed immediately below the stage he had found entirely useless, but that by removing it a certain distance from the object it then ceased to cut off the field, and began to reduce the light and to improve the penetration and definition. With high powers this answered very well, but it would not work with low powers, unless the diaphragm was removed to a distance too great to be convenient in practice. He had therefore devised the plan of introducing a short 1½-inch condenser behind the stage, and about three inches in front of the diaphragm-plate, in this way throwing it out of focus. The effect of this was that the same improvement in penetration and definition was obtained, but on a much shorter distance. Attention was also called to a method of clamping the object in position when the focus had been obtained; also to a plan for obtaining a fine adjustment by a tangent screw. Mr. Mills's note on "A Sponge with Stelliform Spicules" was read. Mr. Crisp referred to some comments which had recently been made in America upon the advantages of the method of tilting the stage of

the microscope as a means of obtaining a very economical and simple fine adjustment, on which some discussion took place. Dr. A. C. Stokes's paper on "New Infusoria Flagellata from American Fresh Waters," containing descriptions of twenty new species, was read. Messrs. H. W. Burrows, C. D. Sherborn, and Rev. G. Bailey's paper on "The Foraminifera of the Red Chalk" was also read.

THE VICTORIA (PHILOSOPHICAL) INSTITUTE.

The annual general meeting of this Society was held on the 4th of June, and was largely attended. The President, Professor G. G. Stokes, P.R.S., M.P., took the chair. The twenty-second annual report was read by Captain Frank Petrie, the Honorary Secretary, and referred to the continued progress of the Institute, which now numbered 1,300 members, and to the constantly increasing number of prominent men in that great body of scientists, of whom every Englishman was so justly proud, who were joining the Institute and taking part in its work. Much of that work tended to aid science, and some of a special character tended to show the error of those who sought to attack religion in the name of science. Sir J. Risdon Bennett, F.R.S., moved the adoption of the report, and referred to the important volume of Transactions just issued as sufficient evidence of the sound principles on which the Institute was conducted. Professor H. W. Bristow, F.R.S., Senior Director of the Geological Survey, seconded the adoption of the report, and complimented the Council on the excellent way in which their work had been done. Mr. David Howard, F.C.S., returned thanks on behalf of the Council.

Sir Monier Williams then delivered the address on "Mystical Buddhism." He commenced by showing that, to the Buddhist, Bodhi, or true knowledge, was knowledge acquired through the intellectual faculties, explaining that originally Buddhism abstained from mysticism, which was developed through the connection of Buddhism with the "Yoga" system, or system of contemplation, to bring about the so-called "union" of man's spirit with the spirit of the universe. With the Buddha creation did not proceed from an Omnipotent spirit evolving phenomena by the exercise of an Almighty will, and he did not believe in the eternal existence of the soul. He regarded every man as created by the force of his own acts in former bodies. Sir Monier then explained all the various methods of fasting self-torture practised by the Buddhists with a view to bringing their bodies into subjection to their spirits, and to the trance-like states induced, and pointed out that the so called spiritualism, Neo-Buddhism, and theosophy, animal magnetism, clairvoyance, thought-reading, etc., of the present day had their counterparts over two thousand years ago in India, but it was to be doubted whether they would bear the searching light of European scientific examination.

The Bishop of Dunedin moved a vote of thanks to Sir Monier Williams, and to those who had contributed to the papers and discussions during the year. These included: Sir J. W. Dawson, K.C.M.G., F.R.S.; M. Maspero, Sir Joseph Fayrer, K.C.S.I., F.R.S.; Sir C. Wilson, K.C.B., F.R.S.; Professor Geikie, F.R.S.; Captain Wharton, F.R.S.; Mr. W. H. Huddleston, F.R.S.; Professors Hull, F.R.S.; Tristram, F.R.S.; Duns, F.R.S.E.; Cowell, Douglas, de Lacouperie, Leitner, Mr. John Murray of the *Challenger* expedition, Dr. Guppy, Admirals Guppy and Scott, and others. As to the annual address, all regarded Sir Monier Williams as one of the leading authorities upon Buddhism, the characteristic of which was that all good was said to spring from within man himself, while Christianity recognised that it came from above. Buddhism itself had failed in practice, and had proved itself unsuited to reasonable men; it was essentially the bare, hollow emptiness described by Sir Monier Williams, and offered nothing but metaphysics and superstition, and esoteric Buddhism was no better.

Mr. W. S. Seton Karr seconded the vote of thanks, and said that from his long experience in India he held very similar views.

Sir Henry Barkly, K.C.B., F.R.S., moved a vote of thanks to the President for his kindness in adding to his duties as President of the Royal Society, Member for his University, and many others, that of presiding guide of the Victoria Institute.

A conversazione was afterwards held in the museum.

HALIFAX SCIENTIFIC SOCIETY.

On May 28th Mr. Robert Law, F.G.S., gave an interesting lecture entitled, "Caves and their Contents." Dr. Solomon C. Smith occupied the chair. The lecturer commenced by explaining that caves may be formed in two ways—the one termed the chemical, and the other the mechanical. Those made by chemical action are always the largest and most important, and are found in limestone districts. Every shower of rain brings down a certain amount of carbonic acid gas in solution from the atmosphere, which has the power of dissolving limestone rock. In this way the softer portions get gradually washed away, leaving hollow cavities. In some instances water flows through fissures or holes in the rocks for a considerable distance underground, so forming caverns which vary in height and width according to the hardness of the material which composes its walls. In some places they may be very wide and lofty, and at others so small that a person can scarcely pass through; this is owing to the softer portions of the rock falling from the roof and sides, and being washed away much quicker than the rest. The caves formed by mechanical means are not very numerous, and never very large. They are mostly found on the seashore, and formed by the force of the waves dashing against them; while in the coal measures and grit rocks we find none at all, simply because there is no substance that will readily dissolve. From the remotest age caverns have been used as dwelling-places by man, but it was not until the year 1822 that any idea was formed of their antiquity. In that year Dr. Buckland first explored Kirkdale Cavern, and not only found traces of man, but also the bones of wild animals which have now become extinct. Since that time cave researches have been carried on with scrupulous care, and it is found that traces of man extend to several periods. In the upper layers are found implements and weapons made of metal (mostly bronze) together with the bones of recent animals; but in the lower layers are implements made in the rudest fashion from flint, and in close proximity are found bones of such wild animals as the rhinoceros, mammoth, hippopotamus, hyæna, cave bear, etc. During the investigation of the old river beds in the valley of the Somme, in France, implements of flint were found resembling those from caves, and supposed to have been made about the same time. The lecturer endeavoured to give some idea of the enormous length of time it must

have taken to lower the bed of the river to its present level, in order to show the great age of these relics, and in conclusion gave a minute description of the researches in Kent's Cavern.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held on June 4th, Mr. A. T. Walmisley, President, in the chair, a paper was read on "The Acton Main Drainage Works," by Mr. C. Nicholson Lailey.

A special interest attached to this paper, on account of its containing a full description of the successful system of the International Purification Company, which system Acton is the first town to adopt.

After glancing historically at the origin of the Acton Drainage Works, and showing that neither a sewage-farm nor the lime process were admissible, the site of the works being near the Bedford Park Estate, and close to an intended public recreation ground, a position which made the entire absence of foul odours, as well as a clear and pure effluent, absolutely essential, the paper gave an account of the formation of the sewers under disadvantageous circumstances, and the details of the works. These are situated on a triangular piece of ground about 5 acres in extent, and comprise precipitating tanks, the chemical buildings, and the pumping station.

The drainage of Acton is divided into two sections, a high and a low level. The high-level sewage flows into the precipitating tanks by gravitation, but the low-level requires pumping. Underneath the pumps is a storage tank for the low-level sewage, capable of holding 50,000 gallons. The precipitating tanks are three in number, and will hold 138,000 gallons of sewage each. In addition to these are two smaller tanks, one of which contains the magnetic spongy carbon filter bed, and in the other it is intended to construct another similar filter when increased population renders it necessary.

The "magnetic process" consists (1) in precipitation of the solids, and (2) in filtration of the effluent through a bed containing a layer of "magnetic spongy carbon." This "magnetic carbon" is a hard material of such remarkable oxydising and aerating powers, that the effluent, after passing through it, is, to quote an independent report of Dr. E. L. Jacob, Medical officer of Health to Surrey Combined Sanitary District, "superior to many potable well waters." The precipitant used is ferrous carbonate, and the mode of applying it is to grind it up into a thin slurry with water or sewage, and then to run this liquor into the sewage as it flows into the precipitating tanks. After allowing the sewage in the tank to settle for about three hours, the effluent is passed through the magnetic spongy carbon filter bed, from which it issues in a state of almost perfect purity, and flows into the Thames. The sludge, which is very dense, is then drawn off into the sludge well, whence it is pumped into the presses. The amount of sludge obtained per week is 18 tons, and, when pressed, this gives 4 tons 10 cwt. of sludge cake, which has all been sold up to date, and fetches 30s. per ton.

The author considered the magnetic process advantageous over all others, because the effluent is not spoilt by the use of lime, the manurial value of the sludge is much increased, the nuisance which exists at most sewage works where lime is used is not created, the Thames is not polluted by it.

The Acton Local Board had at first grave doubts of the efficacy of any filtering bed for sewage, but experiments for a period of nine months convinced them that the "magnetic process" was all that could be desired, and they consequently entered into a contract with the International Purification Company for the supply of their material for a term of five years.

The author and the Acton Local Board, with good reason, pride themselves that after careful investigation they have selected not only the most recent, but the most highly developed of modern sewage processes, at once the most perfect and the most economical. In the tanks the solids are removed and the fluid defecated and deodorised, and in the filter bed the deodorised fluid is purified from the organic matter in solution, so that the effluent produced is the most perfect yet obtained; and these advantages are had without the great expense attending the use of land for a sewage farm, which, they contend, is no longer a necessity.

GEOLOGICAL SOCIETY OF GLASGOW.

At the concluding meeting of the thirtieth session, held on May 31st, Mr. John Young, F.G.S., exhibited a specimen of the bed of intrusive dolerite found in connection with the carboniferous strata in which the fossil trees are imbedded at Victoria Park, Whiteinch. In one of the veins of the igneous rock recently exposed, and which has been found to pass through the roots of one of the trees, the remains of a glassy surface on either face where it had cooled most rapidly are found. These glassy faces show a spherulitic structure, in which the spheres have polygonal outlines from pressure contact when the rock was still in a fluid condition. A finely radiated structure has also been developed, much like that seen in the Arran spherulitic pitchstones At Whiteinch, however, the rock shows the radiation only in parts, owing to the devitrification which has taken place long subsequent to its injection.

Mr. Robert Dunlop read an interesting account of a peat bed he had lately discovered, surrounded by boulder-clay, in the neighbourhood of Airdrie, and the presence of which in its peculiar position opened up many geological points of considerable importance.

The Hon. Secretary read a paper forwarded by Mr. James Bennie, of the Geological Survey, on "The Redemption of Sandstone Quarries," in which the author showed how the most unpromising fields to the geological eye, in the shape of worked-out or long-disused sandstone quarries, might be made to yield treasures of old-world life in the shape of plant remains, and portions of scorpions, eurepterids, and other air-breathing creatures, although, curiously enough, no traces of the insects on which these animals preyed had as yet been discovered. There was still ample scope for the diligent and sharp-eyed collector to make important discoveries in this direction.

THE ARCHÆOLOGICAL INSTITUTE.

At the monthly meeting held on June 7th, Mr. J. T. Micklethwait, F.S.A., in the chair, the papers read were (1) "On the Discovery of of a Curious Structure, supposed to be the Cell of an Anchorite," at Ongar, between Epping and Chelmsford, Essex, by the Rev. E. S. Dewick; and (2) "On Norman Masonry, and Masons' Marks," by Mr. J. Park Harrison. Each of the two papers was followed by a discussion, in which Messrs. Micklethwait, Hope, Scarth, and Walford took part.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

CRICKET STUMPS.—Mr. J. Caffarey has patented cricket stumps, which consist in fitting the lower ends of the stumps into sockets attached to plates, which are provided with spikes for fixing in the ground.

SUPERHEATING GAS FOR LIGHTING.—An apparatus for superheating gas for lighting and other heating purposes, has been patented by Messrs. Torkington and Ewins, of Birmingham. The gas before passing to the burner is superheated by traversing a pipe or pipes above the flame, or else the gas entering by a channel ascends a pipe to a chamber, where it is heated before returning by a second tube to the burner. As adapted to gasaliers a chamber is carried over each burner by radial concentric tubes connected with the down pipe.

AMMETER.—Messrs. W. E. Ayrton and J. Perry have patented an ammeter. The instrument consists of straight, fine, parallel wires of conducting material fastened at both ends to supports, one of which is insulated, fixed inside a short horizontal tube. The wires are attached at their middles by means of a stirrup and a fine wire connection to one end of a magnifying spring under tension. The other end of the spring is fixed so that its axis is at right-angles to that of the wires. On passing a current through the wires joined electrically, they stretch slightly, causing a pointer attached to the end of a magnifying spring to rotate, and the amount of rotation measures the current passing through the instrument without the employment of multiplying gearing. When used as an ammeter, a shunt is attached to the wires, the shunt consisting of a metallic rod, which is longer than the wires, and so does not heat.

SIGNALLING APPARATUS.—Mr. C. Bade has patented an acoustic signalling apparatus. In this apparatus carbonic acid gas is utilised for sounding the signals instead of steam. The apparatus consists of a reservoir capable of withstanding considerable pressure. A foghorn is secured to this reservoir by brackets, and has communication with it through a pipe provided with a cock; the reservoir is provided with a safety valve and pressure guage. Metal cylinders for containing carbonic acid are also connected to the reservoir by pipe unions, and have valves. These cylinders are easily removable. To operate the apparatus one of the valves in the cylinders is opened, and the carbonic acid being released from pressure becomes gaseous, flowing into the reservoir until a desired pressure is attained therein. The valve is then closed, and by opening the cock communicating with the horn, the compressed gas escapes and sounds the signal.

CONTROLLING ELECTRIC CURRENTS.—Mr. H. Edmunds has patented means for controlling, transforming, regulating, synchronising, and registering electric currents. The object to be attained is to convert currents of one kind apart from the generator into currents of a different character, for transforming an alternating current into a continuous current for storing in secondary batteries and operating motors. The alternating current is passed through a series of magnets with poles alternately reversed, and in proximity to this series is another corresponding series of permanent magnets, magnetised from any convenient source. These two series of magnets have motion relatively to each other obtained from any motor; in connection with these series is a commutating arrangement, to which the alternating current to be transformed is led, and by the collectors of which it is taken off as a continuous current. The moving parts are also connected to a counter for registering purposes.

PULSOMETER.—A pulsometer has been patented by Mr. J. Reid. This pulsometer is provided with a steam-moved piston valve controlling the admission of steam. The construction is as follows:—The body of the pulsometer consists of two chambers, rectangular at the lower part and at the upper part tapering, and terminating at the top in an aperture for the admission of steam. Each of these working chambers is furnished with a suction and a delivery valve, and is provided near the top with a small vent fitted with a regulating valve. The upper apertures of the working chambers communicate by passages with the interior of a cylindrical valve chest on either side of a disc valve. This valve is contained in a cavity within the valve chest, and whilst the apparatus is at work, steam is admitted to this cavity by opening a steam cock provided for the purpose. The disc valve resting at one end of the cavity bars the passage for the steam in this direction, but leaves it free to pass out of the cavity at the other end, and thence into one of the working chambers of the pulsometer. In starting the apparatus the disc valve is moved to and fro in the cavity by means of a handle connected with the valve rod, and worked by hand; but when the apparatus is in regular work the movement of the valve is automatic.

TILL.—Mr. H. T. Davis has patented an automatic recording till. On the top of the money-box and in communication with it is fixed an upright tube for the passage of coin. A metal case, double-fronted, revolves upon this tube, the revolution being in one direction by means of a pawl and ratchet wheel. On each face is an opening covered by a plate of glass, and behind this and affixed to the inside of the case is a frame with a back and a drop-shelf. Above this frame is a slot in the casing for dropping in the money on to the shelf. This shelf is pivotted, and extends beyond the back of the frame, resting upon the top of the tube. A portion of the tube is cut away, so that, when the casing is rotated, and upon reaching the cut-away portion, the drop-shelf drops, and the coin slides down the same into the tube and so to the money-box. Upon a platform is a roll of paper passing over a face to a drum. This drum has a ratchet wheel controlled by a tooth upon the tube. When the casing is rotated, a portion of the paper corresponding to an aperture in the casing is drawn on to the drum. When a coin is dropped through the slot upon the drop-shelf, the amount is written upon the paper; the machine is then revolved, and the customer sees his coin and the amount properly entered. When the next payment is made, the machine is revolved, the drop-plate drops the coin into the tube, the paper containing the figure is drawn away, forming a continuous record upon the drum of the amount received, and leaves a blank space for the next entry.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

POISONS IN THE WORKSHOP.

In your last volume you inserted a very instructive article on "Poisons in the Household," and you suggested at the close that you might at some future time take up the question of "Poisons in the Workshops." I am, I believe, not the only one of your readers who is looking forward to the fulfilment of this promise. CONSTANT READER.

[Our correspondent is, possibly, a thought reader. We have sketched out such an article, which will soon be completed.—Ed. SCIENTIFIC NEWS.]

DREDGING EXPEDITION ON THE HYÆNA.

Your report, published on June 8th, omits to mention that the party was under the direction of Prof. Herdman, of Liverpool, to whose good management we must attribute the success of this little expedition. L. C. M.

"WORK FOR NATURALISTS' CLUBS."

A few weeks ago you gave us two very interesting articles on this subject (SCIENTIFIC NEWS, pp. 446 and 469). In one of these you say: "Now is the publication of local lists a resource of any value? This kind of literature is terribly overdone." This statement is perfectly true as regards the Lepidoptera and the Phaneregamous flora of most parts of Britain. But the same can scarcely be asserted concerning the mosses and fungi, the land and fresh-water shells, and the orders of insects other than the Lepidoptera and perhaps the Coleoptera. The local distribution of all these forms of life, and especially their connection with the geological characters of the districts, need much further investigation.

SIGMA.

SAND GROUSE.

Some of the sand grouse of which you give a notice in this week's number, were shot in Northumberland on the 29th of May; three of them came under my notice. I found that if they had been spared they would probably have been nesting by this. Their crops contained barley, some small seeds, the seeds of grass, and the chrysalis of some small fly or moth. Two or three small packs have been seen passing over this neighbourhood. JOSEPH P. NUNN.

Royston, June 8th, 1888.

IS THE BURNET-MOTH PROTECTED?

Can you or any of your readers inform me whether the common six-spot burnet-moth (*Zygaena filipendulæ*) is specially protected by an offensive smell, a bad taste, or by poisonous properties? Its slow flight and its striking appearance, joined to its habit of sitting on roadside flowers in the full sunshine, make me think that such must be the case. Were it an acceptable morsel it would be seized by birds.

REGNER.

[The moth in question has an unpleasant smell. As to its taste, not having joined the new insect-eating movement, we cannot say.—Ed. SCIENTIFIC NEWS.]

WATER SPOUT IN YORKSHIRE.—A waterspout caused immense destruction to growing crops on several farms at Lantoft, near Driffield, on Saturday afternoon the 9th inst. The water excavated one field in several places to the depth of 7 ft. and swept hundreds of tons of soil and gravel from arable lands, laying them bare to the rock. One farmer had seven acres of turnips wholly destroyed, The water afterwards swept into the village and flooded the houses.

TECHNICAL EDUCATION.

THE BILL FOR THE PROMOTION OF TECHNICAL INSTRUCTION.—The following is the Bill for the promotion of technical instruction, introduced by the Government:—

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

1.—(1) Any School Board in England may from time to time supply or aid the supply of such manual or technical instruction, or both, as may be required for supplementing the instruction given in any public elementary school in its district, whether under its own management or not.

(2) Manual or technical instruction shall not be supplied or aided under this section except for such scholars as—

(*a*) are recognised by the Education Department as in attendance at a public elementary school and receiving instruction in the obligatory or standard subjects prescribed by the minutes of the Education Department for the time being; and

(*b*) (in the case of technical instruction only) have obtained from the Education Department certificates of having passed the examination in reading, writing, and arithmetic, prescribed by the standard set forth in the schedule to this Act, or an examination equivalent thereto.

(3) For the purpose of supplying or aiding the supply of manual or technical instruction under this section, a School Board shall have the same powers, but subject to the same conditions, as it has for providing sufficient public school accommodation for its district, subject to this restriction that the amount of the rate to be levied in any one year for the additional purposes authorised by this section shall not exceed the sum of *one penny in the pound*.

2.—(1) If a School Board aids the supply of manual or technical instruction in any school or schools under its own management, it shall, on the request of the managers of any other public elementary school in its district fulfilling like conditions as to the supply of manual or technical instruction in conformity with the requirements of the Department of Science and Art, and on proof of sufficient demand for such instruction in that school, aid the supply of such instruction in that school in like manner as it aids such supply in the school or schools under its own management, subject to such terms as may be agreed on or determined in pursuance of this Act.

(2) If the managers of a public elementary school in the district of a School Board object to the terms on which the School Board proposes to aid the supply of technical instruction in that school, the Department of Science and Art shall, on the application of those managers, determine whether the terms so proposed are reasonable.

3.—(1) Any local authority empowered to carry into execution the provisions of the Public Libraries Acts with respect to the establishment and maintenance of public libraries, public museums, schools for science, art galleries, and schools for art, may from time to time supply or aid the supply of technical instruction by providing or aiding in the provision of teachers, apparatus, or buildings to such extent and on such terms as the authority think expedient, and may exercise its powers under this section either with or without exercising any of its powers under the Public Libraries Acts.

(2) Provided as follows:—

(*a*) In a district for which there is a School Board, the local authority shall not out of their own funds supply or aid the supply of technical instruction suitable for scholars receiving at a public elementary school instruction in the obligatory or standard subjects prescribed by the minutes of the Education Department for the time being, except to the extent, if any, to which the authority was so supplying or aiding before the establishment of a School Board.

(*b*) In a district for which there is not a School Board, the managers of a public elementary school shall not receive aid under this section except for scholars for whom technical instruction may be supplied or aided by a School Board in a district for which there is a School Board.

(3) The amount of the rate to be levied in any one year

under the Public Libraries Acts as amended by this Act for the additional purposes authorised by this section shall not exceed the sum of *one penny in the pound*, and where the powers given by the Public Libraries Acts are exercised concurrently with the powers given by this section shall not exceed *twopence in the pound*.

4.—(1) The managers of any technical school in the district of a School Board or local authority may make an arrangement with the Board or authority for transferring their school to that Board or authority, and the Board or authority may assent to any such arrangement.

(2) The provisions of section twenty-three of the Elementary Education Act, 1870, with respect to arrangements for the transfers of schools, shall apply in the case of arrangements for the transfers of schools in pursuance of this section.

5.—Every minute of the Department of Science and Art with respect to the condition on which grants may be made for technical instruction shall be laid on the table of both Houses of Parliament within three weeks after it is made, if Parliament be then sitting, and if Parliament be not then sitting, within three weeks after the then next session of Parliament, and shall not come into operation until one month after being so laid.

6.—In this Act—

The expression "technical instruction" means instruction in the principles of science and art applicable to industries and in the application of special branches of science and art to specific industries or employments. It does not include teaching the practice of any trade or industry or employment, but, subject as aforesaid, includes instruction in the branches of science and art with respect to which grants are for the time being made by the Department of Science and Art, and any other form of instruction which may for the time being be sanctioned by that Department by a minute laid before Parliament and made on the representation of a School Board or local authority that such a form of instruction is required by the circumstances of its district.

The expression "technical school" means a school or department of a school which is giving technical instruction to the satisfaction of the Department of Science and Art.

The expression "manual instruction" means instruction in the use of tools and modelling in clay, wood, or other material.

The expression "the Education Department" means the Lords of the Committee of Her Majesty's Privy Council on Education.

The expression "local authority" means the Council, Commissioners, Board, or other persons or authority carrying into execution, or empowered to carry into execution, the Public Libraries Acts.

The expression "Public Libraries Acts" means the Public Libraries (England) Acts, 1855 to 1887, and the Public Libraries (Ireland) Acts, 1855 to 1884.

7.—This Act may be cited as the Technical Instruction Act, 1888.

SCHEDULE.

STANDARD.

Reading.—To read a passage from some standard author.

Writing.—A short theme or letter on an easy subject, spelling, handwriting, and composition to be considered. An exercise in dictation may, at the discretion of the inspector, be submitted for composition.

Arithmetic.—Fractions, vulgar and decimal, simple proportion, and simple interest.

IMPROVED TINS FOR MEAT AND VEGETABLES.—Serious mischief has been occasioned by the action of the juices of fruits, etc., upon the solder used in closing the tins, especially when chloride of zinc is used in the process. This substance is a powerful irritant poison, and very easily dissolves in the juices of the food. To avoid this danger tins have been devised with screw tops. We fear, however, that the expense of this improvement will interfere with its common adoption.

ANNOUNCEMENTS.

ROYAL SOCIETY.—At the meeting on Thursday, May 31st, the following gentlemen were elected foreign members to fill the four vacancies existing:—Prof. Edmond Becquerel, of Paris; Prof. Hermann Kopp, of Heidelberg; Prof. E. F. W. Pflüger, of Bonn; Prof. Julius Sachs, of Würzburg.

THE INSTITUTION OF CIVIL ENGINEERS.—The Council has awarded the following premiums for some of the original communications presented during the past session, on account of the science, talent or industry displayed in the consideration of the several subjects dealt with, viz.:—*For Papers read and discussed at the Ordinary Meetings*—A Telford medal and a Telford premium to Robert Abbott Hadfield, Assoc. M. Inst. C.E., for his papers on "Manganese in its Application to Metallurgy," and "Some Newly discovered Properties of Iron and Manganese"; A Watt medal and a Telford premium to Peter William Willans, M. Inst. C.E., for his paper on "Economy-Trials of a Non-condensing Steam-Engine, Simple, Compound, and Triple"; a Telford medal and a Telford premium to Edward Hopkinson, M.A., D.Sc., Assoc. M. Inst. C.E., for his paper on "Electrical Tramways: the Bessbrook and Newry Tramway"; a Watt medal and a Telford premium to Edward Bayzand Ellington, M. Inst. C.E., for his communication on "The Distribution of Hydraulic Power in London"; a Telford medal and a Telford premium to Josiah Pierce, Jun., M.A., Assoc. M. Inst. C.E., for his paper on "The Economic Use of the Plane-Table in Topographical Surveying"; a George Stephenson medal and a Telford premium to Sir Bradford Leslie, K.C.I.E., M. Inst. C.E., for his account of "The Erection of the 'Jubilee' Bridge, carrying the East Indian Railway across the River Hooghly at Hooghly;" and the Manby premium to the late Hamilton Goodall, Assoc. M. Inst. C.E., for his paper on "The Use and Testing of Open-hearth Steel for Boiler-making." *For Papers printed in the Proceedings without being discussed*—A Watt medal and Telford premium to Professor Victor Auguste Ernest Dwelshauvers-Dèry, for his paper on "A New Method of Investigation applied to the Action of Steam-Engine Governors"; and Telford premiums to William Mann Thompson, M.A., B.E., Assoc. M. Inst. C.E., for his paper "on Improved Systems of Chaining for Land and Engineering Surveys," to James William Wyatt, F.C.H., Assoc. M. Inst. C.E., for his communication on "Sizing Paper with Rosin," and Dugald Drummond, M. Inst. C.E., for his paper on "The Heating of Carriages by Exhaust Steam on the Caledonian Railway." *For Papers read at the Supplemental Meetings of Students*—Miller prizes to David Sing Capper, M.A., Stud. Inst. C.E., for his paper on "The Speed-Trials of the latest addition to 'The Admiral' Class of British War-Vessels," to Lawrence Gibbs, Stud. Inst. C.E., for his account of "Pumping-Machinery in the Fenland and by the Trentside," to Harold Medway Martin, Wh.Sc., Stud. Inst. C.E., for his communication on "Arched Ribs and Voussoir Arches," to John Henry Parkin, Stud. Inst. C.E., for his paper on "River-Gauging at the Vyrnwy Reservoir," to Alfred Chatterton, B.Sc., Stud. Inst. C.E., for his paper on "The Prevention and Extinction of Fires," to John Holliday, Stud. Inst. C.E., for his paper on "Boiler Experiments and Fuel-Economy," to Arthur Wharton Metcalfe, Stud. Inst. C.E., for his paper on "The Classification of Continuous Railway-Brakes," and to Robert Jarratt Money, Stud. Inst. C.E., for his account of "Railway Engineering in British North America."

SOCIETY OF ARTS.—The conversazione of this Society is fixed to take place at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Wednesday, June 20th.

THE HOSPITALS' ASSOCIATION.—A special meeting of the Hospitals Association will be held at the Governor's Hall, St. Thomas's Hospital, on Wednesday, June 20th, at 8 p.m., for the adjourned discussion of a paper by W. Burdett-Coutts, Esq., M.P., on "Contributions by Patients in relation to the Financial Condition of London Hospitals." The chair will be taken by the President, Dr. J. S. Bristowe, F.R.S. Cards of admission can be obtained, on application, from L. Broke Willoughby, Esq., Secretary, The Hospitals Association, Norfolk House, Norfolk Street, W.C.

DIARY FOR NEXT WEEK.

Monday, June 18.—Victoria Institute, at 8 p.m.—*The Botany of Syria;* by Prof. G. E. Post.
Bedford Naturalists' Society, at 7 p.m.—*Reports of Rambles and Exhibits.*

Tuesday, June 19.—

Wednesday, June 20.—Royal Meteorological Society, at 7 p.m.—*First Report of the Thunderstorm Committee. On the Photographs of Lightning Flashes*, drawn up by Hon. R. Abercromby. *The Cold Period from September, 1887, to May, 1888*; by Mr. C. Harding. *Observations of Cloud Movements near the Equator, and on the General Character of the Weather in the Doldrums;* by Hon. R. Abercromby.

Thursday, June 21.—Royal Society, at 4.30 p.m.
Camera Club, at 8.30 p.m. — *Meeting to Compare Results obtained at the Ockham Excursion.*

Friday, June 22.—Royal United Service Institution, at 3 p.m.—*Fire Discipline and the Supply of Ammunition in the Field as provided for by Foreign Powers;* by Captain W. H. James.
British Museum, at 3.30 p.m.—*The Social Condition of the Babylonians;* by Mr. G. Bertin.

Saturday, June 23.—Geological Association. — *Excursion to Godstone and Bletchingley.*
Camera Club.—*Excursion to Abbey Wood, Belvedere, and Erith.*
Physical Society, at 3 p.m.—*Note on Continuous Current Transformers;* by Prof. S. P. Thompson.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Large Assortment of Lathes, Planers, Drilling, Milling, and various new inventions and tools.—BRITANNIA COMPANY, 100, Houndsditch London.—All letters, Britannia Tool Factory Colchester, England. Makers to the British Government.

New Book on the Lathe, with notice of new applianes, metal-spinning, milling, etc., in an ordinary lathe; 3s. post free.—BRITANNIA COMPANY, Colchester.

Chisel Steel, 1 to 5 feet bars, ⅜ to 1½ octagon, 13s. per cwt.—GILBERT, Oxford Road, Sheffield.

Best Cast Steel for tools, taps, and dies, drills, 6d. per lb.—GILBERT, Oxford Road, Sheffield.

Electro-Plating and Gilding successfully taught. Every requisite supplied.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Practical Hints on Electro-Plating, etc. — 1 stamp.—Address, HENRIC, 234, Great Colmore-street, Birmingham.

Fretwork, Carving, Turning, Woods, Tools, and all requisites. Catalogue with 700 illustrations, 6 stamps.—HARGER, BROS., Settle.

Second-hand Lathes, and other tools, offered cheap; on view, Britannia Co., 100, Houndsditch, London.—Send 2 stamps for list, to Britannia Works, Colchester.

5in. Burnishers, 7s. 6d. ! Silver steel bar, warranted: 6½ in., 12s. 6d.; 9 in., 20s.; 15 in., 40s.—C. C. VEVERS, Horsforth, Leeds.

Photographic Specialities, cheap and good.—Stills, head-rests, backgrounds, washing machines, lamps, shutters, etc. Lists free.—C. C. VEVERS, Horsforth, Leeds.

Tricycle, front steerer, Coventry make, good condition, £5, worth double.—ARMY CONTRACTOR, Granville, Sandgate, Kent.

To Emigrants.—Beautiful double Breech-Loader, splendid condition, 3 guineas, approval.—HILLSDON, Harbour House, Folkestone.

Gilding and Electro-plating Taught.—Amateur's Complete Outfit, with Instructions, 21s.; list, 1 stamp.—PERKS, Alexandra Road, Richmond, Surrey.

Dead Black Varnish for Cameras, Lenses, Dark Slides, etc. —Bottles, post free, 1s. 3d.—H. SOUTHGATE, Maidenhead.

Photography. "Vade Mecum."—A serviceable, complete set for 32s. 6d. Everything necesssry for taking, printing, finishing. Photo and particulars free.—MERCER, King Street, Sparkbrook, Birmingham.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.
Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

British Petrography. With Special Reference to the Igneous Rocks. By J. J. Harris Teall, M.A., F.G.S. London: Dulau and Co. Price £3 3s.

Applications of Dynamics to Physics and Chemistry. By J. J. Thomson, M.A., F.R.S., Fellow of Trinity College, and Cavendish Professor of Experimental Physics, Cambridge. With Diagrams. London: Macmillan and Co. Price 7s. 6d.

Horticulture. By F. W. Burbidge, author of "Domestic Floriculture," "Cultivated Plants," etc. Uniform in size and type with the "British Manufacturing Industries." Edited by G. Phillips Bevan, F.G.S. London: Edward Stanford. Price 4s. 6d.

Sound Light and Heat. By the late Thomas Dunman. Revised and Completed by Chapman Jones, F.I.C., F.C.S., Member of the Physical Society of London, etc. With Explanatory Diagrams. London: Ward, Lock, and Co. Price 1s.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, June 4th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	44·0 degs., being 2·0 degs. below average.	5·7 ins., being 0·9 ins. above average.	368 hrs., being 26 hrs. below average.
England, N.E.	45·2 " " 2·4 " " "	4·6 " " 0·1 " " "	329 " " 52 " " "
England, East	46·8 " " 2·9 " " "	2·9 " " 1·2 " below "	375 " " 77 " " "
Midlands ...	46·9 " " 2·5 " " "	3·5 " " 1·2 " " "	337 " " 57 " " "
England, South	47·5 " " 2·8 " " "	3·5 " " 0·7 " " "	369 " " 47 " " "
Scotland, West	45·0 " " 2·0 " " "	8·2 " " 2·2 " above "	368 " " 40 " " "
England, N.W.	45·5 " " 3·0 " " "	3·6 " " 1·0 " below "	329 " " 81 " " "
Scotland, S.W.	47·4 " " 2·7 " " "	4·4 " " 1·5 " " "	404 " " 35 " " "
Ireland, North	46·3 " " 2·6 " " "	4·4 " " 0·2 " above "	336 " " 65 " " "
Ireland, South	48·2 " " 1·8 " " "	6·3 " " 0·3 " " "	378 " " 58 " " "
The Kingdom...	46·3 " " 2·5 " " "	4·7 " " 0·2 " below "	359 " " 54 " " "

Scientific News

FOR GENERAL READERS.

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SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

NATURALLY connected with my last is a very interesting question that has been much discussed, viz., whether the inclination of the earth's equator to the plane of the earth's path around the sun has been, or may be, materially changed. As we all know, this inclination now amounts to 23½ degs. (23 degs. 28 mins.), or, otherwise stated, the axis of the earth does not stand upright at it proceeds around the sun, but leans over to the extent above-named. Has this leaning over ever been greater or less? May it hereafter become greater or less? These are the questions to which I refer, neglecting altogether the well-understood and undisputed actual elliptical oscillation or nutation which is of insignificant account, and has a recurrent period of about 19 years.

I need scarcely add that to the leaning of the earth's axis, and its persistence in leaning in the same direction throughout its annual journey, we owe all the phenomena of changing seasons, as each hemisphere must during one-half of its journey lean towards the sun and during the opposite half be turned to the same extent away.

Geological phenomena indicating great changes of climate in given parts of the earth, which otherwise are not easily accounted for, present strong temptations to speculate upon changes in the inclination of the earth's axis. Two kinds of such change have been imagined. First, that the position of the axis relatively to the earth itself has changed, *i.e.*, instead of rotating as at present equally around an imaginary line extending from the present north to the present south pole, it has rotated about some other line, changing the position of the poles accordingly.

This hypothesis is so violent that it scarcely needs discussion. If the earth were a perfect sphere and perfectly rigid, such instability of axis might be a fair subject for consideration, but the earth being a spheroid of rotation the whole mass of its equatorial protuberance resists the change, and must either be transferred to the new equatorial region, or it would be continually acting to restore the old position should any great internal commotion change it. Such a change as supposed involves a breaking up of the earth, a transfer of its oceans and rupture of its crust, by earthquakes exceeding in magnitude the greatest of those indicated by geological phenomena.

The other idea is that the earth, as a whole, may have tilted a little, the poles and equator remaining the same so far as the earth itself is concerned, but the apparent daily path of the stars changing on account of the difference of direction of the actual rotation of the earth.

The possibility of this is stoutly denied by the majority of astronomers. They are not, however, unanimous. I was present at the Dublin meeting of the British Association when it was proposed to conclude the meeting of the geological section with a "Donnybrook" on this subject, but unfortunately time did not permit. It is not my present intention to wield a shillelagh on either side, but by giving rein to the imagination to discuss the instructive question of what would happen, if, by some internal shifting or external impulse, the earth should swing through 23½ degs. and its axis of rotation stand upright in reference to the path of its revolution about the sun.

We should then, as regards the incidence of the solar radiation, be permanently in the position we now occupy at the periods of the vernal and autumnal equinoxes, at or about 21st March and 21st September. The shadow limit separating day and night would pass perpendicularly across the equator from pole to pole. Excepting in the polar regions, day and night would be always nearly equal. At the poles there would be everlasting daylight. The sun would there be seen as a golden ball bowling steadily round the horizon in twenty-four hours; due north at the midnight of other places, due south at noon, and due east and west at 6 a.m. and 6 p.m.; he would not appear exactly touching the horizon, but standing a little more than half his own diameter above it. This curious state of astronomical affairs actually

prevails in the present order of things at the time of the vernal and autumnal equinoxes, and will be seen by the explorers who shall hereafter reach either pole and remain there at these seasons.

The lift above the horizon is due to refraction, which gives to the sun or moon on the horizon an apparent position of 33 min. (rather more than their own diameter), higher than their actual position. In our supposed condition of upright axis this refraction would make the day a little more than 4 minutes longer at the equator, and such advantage of day over night would progressively increase with the latitude, until all the country within a circle of about 100 miles diameter around each pole would be a region of everlasting sunshine. Real night would be unknown over a far greater area, owing to the twilight, which would continue until midnight to latitudes about corresponding to that of the town of Hammerfest, in Norway, now so easily reached by holiday excursionists.

The distinctive polar climate would then be exactly the opposite to that which now prevails. As I showed last week, it is now distinguished by its great extremes of summer heat and winter cold. It would then be—so far as concerns solar radiation—absolutely equal year after year, and through centuries on for ever, with not even the difference of day and night.

The rest of the world would have no seasons, though subject to the variation of day and night temperatures. The behaviour of vegetation would be very remarkable, seed-time and harvest whenever you please. A wheat-field might be divided into 365 or fewer equal parts, and one part reaped every morning, tilled every day, and sown every evening. The same with everything else. By selection of trees and shrubs, daily ripening might be secured. I say 365 *or fewer* equal parts, because the year as we now understand it would cease to be an epoch. Every day being astronomically like every other, each particular plant would have its own particular period. If the interval between the sowing and ripening of wheat were, say, 200 days, then the daily wheat harvest would be secured by 200 instead of 365 sections of the wheat field.

Fruit trees would probably contract very irregular habits, one branch in bud, another in flower, and the rest in various stages of ripening fruit at the same time, as orange trees partially behave in insular and slightly varying climates now.

Man would become quite a different creature, not only in his physical habits, but morally also. He would require no granaries nor stores of any kind of food, would live from hand to mouth, and thus the primary necessity for thrift would not exist. At present it takes twelve months to produce a loaf of bread, a leg of mutton, or a sack of wool, and we all have to be fed and clothed in the meantime, are thus all dependent on the savings of somebody; those who have not saved must sell their labour to those who have, or starve while the produce of their present labour is ripening. Hence originates the distinction between capitalist and labourer.

The whole social edifice built upon this necessity would fall to pieces by a slight tilt of the earth's axis, and a multitude of other changes which the reader may work out for himself would follow, showing how all the existing proceedings of vegetable, animal, and most especially human, life are dependent on astronomical conditions.

THE FIRST GEOLOGICAL MAPS.

OUR countryman, Martin Lister, was probably the first to conceive the idea of marking on a map the different kinds of rocks found beneath the surface. Yorkshire, a county familiar to him from infancy, and one in which there is a regular succession of conspicuously diverse rocks, was the district which he took as an example. In 1683 he proposed to the Royal Society that a "soil or mineral map" should be constructed. "The soil," he says, "might either be coloured by a variety of lines or etchings, but great care must be taken very exactly to note on the map where such and such soils are bounded. As for example, in Yorkshire:—1. *The Wolds* (chalk, flint, etc.); 2. *Blackmoor* (moors, sand-stone, etc.); 3. *Holderness* (bog, turf, clay, sand, etc.); 4. *Western Mountains* (moors, sand-stone, coal, iron-stone, lead-ore, sand, clay, etc."). Further on he gives the significant opinion that "such upper soils, if natural, infallibly produce such under minerals, and for the most part in such order."

Since Lister's map of soils was never actually made, we have to come down a hundred years to the date of the first geological maps which we can discover to have been engraved and published. These bear the title of "Atlas Descriptif et Minéralogique de la France," par MM. Guettard et Monnet (folio 1780). Guettard was originally a botanist, and was elected as such to the Academy of Sciences in 1743. The Duke of Orleans made him Curator of the Natural History Collection in the Palais Royal. Latterly he gave himself up entirely to what he called mineralogy, which had then come to include all kinds of information respecting rocks and soils. Guettard was really what we should now call a geologist. He undertook to map the rocks of France, but finding, in 1763, that the task was too great for one man, he persuaded Lavoisier to share his labours. Lavoisier was then a young man of fortune; he was chiefly addicted to meteorology, but had already entered upon the chemical researches which were to render his name illustrious. He made many geological excursions to collect materials for Guettard's atlas, not only noting the mineral substances found in different places, but determining heights by the barometer, and analysing all the remarkable mineral waters. The detailed journal of one of Lavoisier's journeys, made in 1760, is still extant,* and gives a lively idea of scientific travel in the last century. By 1770 sixteen maps had been engraved at the expense of the Royal treasury. The atlas was planned to contain two hundred and thirty, and the whole estimated cost amounted to 85,000 livres (about as many francs), but funds were not to be had to meet so great an expense. It was determined to reduce the atlas to twenty-eight maps, and for these 45,000 livres were required. Of this sum 18,000 were solicited from the King, but the national finances were seriously overburdened and the money could not be found. The maps already engraved fell at length into the hands of Monnet, Inspector-General of Mines, who won cheap credit by publishing them as the joint work of Guettard and himself. Lavoisier was not named, and his results were simply stolen by another. Guettard and Lavoisier's maps cannot be called stratigraphical; they are rather geographical maps on which a good deal of information about soils, mines and minerals is noted. Measured sections are engraved in the margin. The conception of a regular succession of strata had already

* See "Revue des Deux Mondes,' December 15th, 1887, p. 837.

entered some few minds, but could not as yet be applied to the mapping of a large extent of country.

The next and greatest step towards a serviceable geological map was taken by an Englishman. William Smith, having discovered the method of identifying rocks by means of the fossil remains which they contain, undertook to prepare a stratigraphical map of England and Wales. His occupation, that of mineral surveyor and civil engineer, gave him abundant opportunities of observation, and he had by nature the faculties most needed by a geological explorer, a good eye for country, and a rapid yet accurate appreciation of broad features. In 1815 he published his large "Geological Map of England and Wales, with part of Scotland," on a scale of five miles to the inch. Smith's map was the first stratigraphical map constructed upon sound principles, and it is surprising to find by actual inspection how good it is, how truly the main lines, at least, are laid down, and how much valuable information is to be got from it. The far more elaborate maps of the present day are constructed upon Smith's principles. He drew the sketch, and a thousand patient hands have filled in the details.

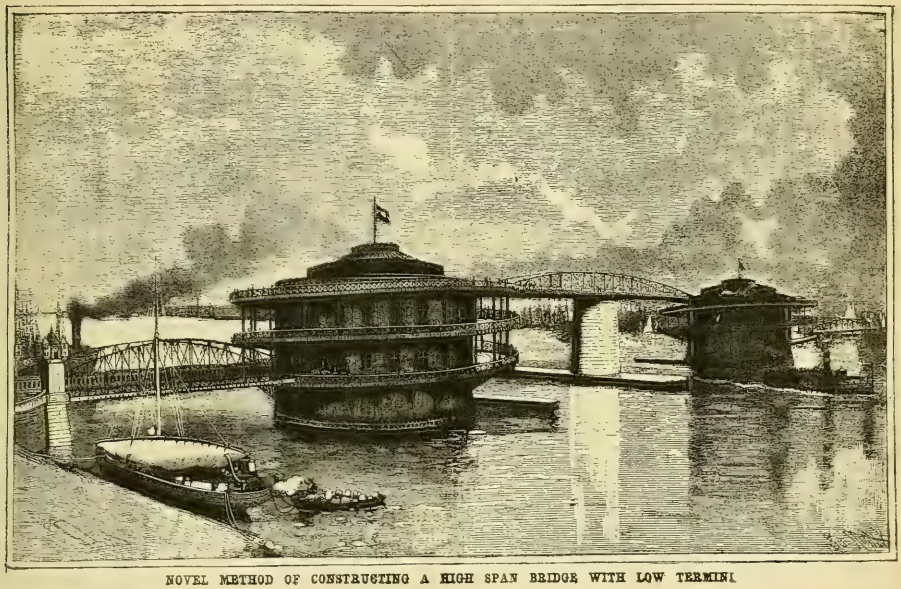
It was fitting that geology, which as Huxley has observed is one of the two intensely Anglican sciences, should receive from two Englishmen the first hint and the perfected method of its fundamental operations.

TARDY JUSTICE.—The portrait of the astronomer Leferrier, of whom France has every reason to be proud, has just been secured for the nation at the small price of 300 francs. Hitherto it has been excluded from the Observatory from political motives!

PROPOSED HIGH-LEVEL BRIDGE FOR AMSTERDAM.

AS the population of Amsterdam increases, it becomes more and more necessary to build houses on the other side of the North Sea Canal, but few persons would care to live there without easy means of access, such as only a bridge can afford.

The accompanying illustration, which we borrow from *Scientific American*, represents an ingenious proposal for crossing the canal by means of a high-level bridge with low-level approaches. The traffic on the canal is very considerable, so that it would be out of the question to open the bridge for every passing vessel. Further than this, many of the vessels are of large size while the banks of the canal are little above the water level. It will thus be seen that the task of designing a suitable bridge presented many difficulties, especially as it was impossible to have long approaches at each end of the bridge.



NOVEL METHOD OF CONSTRUCTING A HIGH SPAN BRIDGE WITH LOW TERMINI.

The bridge we illustrate was designed by Mr. E. Haverkamp, and it consists of a centre high-level swing bridge, which connects two circular towers of large diameter. On each of the towers is a spiral roadway leading from the high-level bridge to a low-level bridge springing from the banks of the canal. Small steamers and other vessels of moderate size can pass to and fro under the high-level bridge, and it is only necessary to open the latter when a large vessel has to pass. The approaches are of the simplest kind, and very little land need be purchased for them.

Each of the towers is 143 feet in diameter, and the spiral roadways are wide enough for a tramway, two

lines of carriages, and a footway. After having completed one round of the tower the vertical ascent is equal to about 14 feet. The clear opening of the swing bridge is 91 feet, and the distance between the underside of this bridge and the water is about 49 feet. It is proposed to fit up the inside of the towers as offices or shops.

WHAT IS A "GENERALISED" PORTRAIT?

THIS question pertains to one of the most interesting of the many important applications of photography—an application which will doubtless lead to results scarcely as yet anticipated. If we consider a portrait, whether photographic or of other kind, if only it be accurate, we must admit that it blends a great variety of impressions. The photograph of John Styles exhibits, in the first place, characteristics peculiar to himself alone, and which serve to distinguish him from all other human beings. But it further reveals features or expressions common to John and to his brothers, his father, his uncles, and, in short, to all members of the Styles family, and which at once distinguish them as a class from any member of the Nokes family over the way. The ordinary phrase, "family likeness," recognises the existence of such traits.

Going a step further, we find that the portrait in question shows points common to all the Styles, to all the Nokes, and, generally speaking, to all Englishmen; and which differentiate them as a body from all Frenchmen, Spaniards, or Italians. Here, again, we have common observation with us, since we not unfrequently hear it said that some person has a genuine English face, or, on the contrary, that he has a foreign look. But the portrait may have still more to reveal. Suppose John Styles aforesaid has for years followed some occupation or expression, associating chiefly with certain classes of persons and being conversant mainly with some set of ideas. Say, to "fix our ideas," that he is a member of the Stock Exchange. Is it not possible that we may find in him something common to stock or share brokers in general, and not common to men engaged in other callings?

Now, the idea occurred some years ago to Mr. Francis Galton, F.R.S., a cousin of Charles Darwin, that if we could throw together in some manner the portraits of all the Stokes family, those features which are peculiar to John Stokes would relatively disappear, and those which are the common attributes of the Stokes would come into prominence, thus yielding a generalised portrait of the "Stokes" family. This suggestion has been carried into successful operation on several occasions, and that with the most remarkable results. Two very instructive "generalised" portraits were produced at the joint meeting of the British and the American Associations for the Advancement of Science. As a great number of scientific men were present, it was proposed to take generalised portraits respectively of the physicists and the naturalists, or, to speak more accurately, the biologists. Each group included men of different nationalities—English, Irish, Scottish, Americans, Germans, and Canadian French. But when the two portraits were completed it was found that in each there was a characteristic something not capable of being rendered in words, which differentiated the one group from the other.

In like manner it will be possible to determine the type of different races and tribes whom explorers encounter in their travels, as a generalised portrait will depict not the mere individual, but the race to which he belongs.

A very curious application of the same idea is the production of what may be called—contradictory as the words may sound—a generalised portrait of an individual. It is well known that one and the same person, especially if he has what is commonly called an expressive countenance, may appear very different at different times, according to his frame of mind, his state of health, and other varying conditions. If, then, we have a number of portraits of such person, each accurate for the moment when it was taken, we may obtain from them a truly typical portrait. In this manner Mr. Galton has photographed six antique medals of Alexander the Great and five of Cleopatra, and has obtained images of each finer and more characteristic than any of the medals taken separately.

But now comes the question, How are such generalised photographs to be obtained? To this end a variety of methods have been proposed. The first step was the use of the stereoscope. But in this manner only two images were superimposed, which was quite insufficient for producing a general type.

Mr. Galton and Mr. Herbert Spencer had the idea of reproducing portraits of the same size upon very thin paper, or upon films, and then laying them upon each other and examining them by transmitted light. Here, also, only a very small number of proofs could be employed, and the image obtained was very confused, the general traits being obscured as well as the more peculiar features. On the contrary, what is wanted is that those traits which give, so to speak, the key-note of the generality should be brought out the most strongly, whilst the others should be less and less accentuated in proportion as they belong more and more to the individual, and should at last disappear completely when they are only the transitory and accidental modification of the physiognomy.

This end may be reached by a photographic procedure recently devised. If a portrait of an individual be taken with an exposure which is quite insufficient, the impression received on the sensitive plate is, of course, so faint that it cannot be developed. If a second portrait be then taken under exactly the same conditions, then a third, a fourth, and so on, continuing the operation as many times as necessary, the totality of the exposures makes up the time necessary for a portrait, and this will be the general result of all the superpositions.

Let us suppose that the complete time for an exposure is sixty seconds, and that we have to combine twenty models, whether they are living persons, portraits previously taken, medals, etc. On exposing each for three seconds, no photographic image is obtained, but by the succession of the twenty objects we have the sixty seconds necessary for the production of a proof to which each will have contributed a twentieth share. Then all the characteristic general traits, being repeated by the twenty objects, are impressed upon the sensitive surface at the same points, and come out with the greatest intensity. In proportion as the traits are more peculiar to single individuals, they come out less and less strongly, and any individual deformity disappears altogether.

A curious result is that the generalised portrait is always more beautiful than any of the individuals who have served for its production. There takes place a kind of idealisation of the expression and the features.

REMARKABLE HAILSTONES.—II.

(*Concluded from p.* 558.)

AS a rule it was found, in these crystalline hailstones, that the growth and prolongation of the crystals had taken place in a plane, corresponding to the direction of the longitudinal axis of the spheroidal nucleus, as may be seen in the figures. However, this rule is not free from exceptions, since it often occurred that ice-crystals, independently developed, had attached themselves to the flattened sides of the spheroid, and appeared to be sometimes deeply rooted in the interior mass of amorphous ice. In making sections of the hailstones, and on breaking them, it was plain that the crystals, when removed, often left behind them an

FIG. 3.

angular depression corresponding in shape to their lower extremity, something like the relation of a tooth to its socket. This was especially the case in stones which, like those of figs 1 and 2 (SCIENTIFIC NEWS, p. 557), were covered with crystals of unusual size.

The spheroids were thus in the majority of cases encircled with garlands of parasitic crystals, a phenomenon which seems closely connected with the causes which determined the lateral flattening of each entire mass. Even the extreme disc-like forms show this connection quite distinctly. Fig. 1 gives a representation of the normal relations between the length and the thickness of these ice-masses, garnished, as will be seen, with a dense series of rhombohedric crystals, some of them as much as 2 inches in length. There were also a few specimens of very indefinite shapes which seemed as if formed by the reunion of half-melted masses. Fig. 3 shows a mixture of sharply-defined crystals and of masses partially melted. But the texture and the porosity of the most irregular masses showed a nearer approach to the primary spheroidal nucleus than to the secondary parasitic crystals. The ice of these varieties displayed in general the blueish colour of glaciers.

From a comparison of the dimensions of the hailstones represented in figs. 1 to 4, the maximum length was 4 inches by $2\frac{1}{4}$ inches in thickness. The weights of the

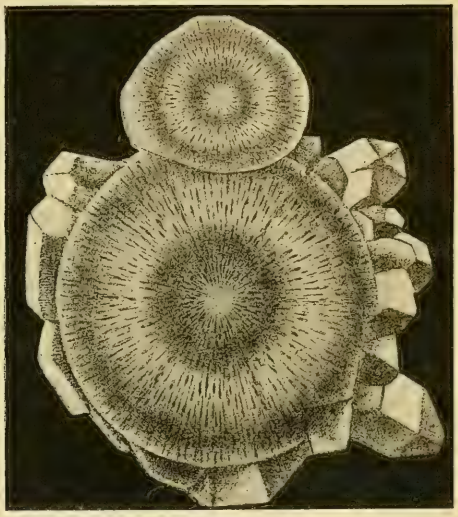


FIG. 4.

largest stones, as determined by the observer, ranged from $3\frac{1}{2}$ to 4 ozs. The ice melted remarkably slowly at the atmospheric temperature of 62° Fahr.

The next morning it was observed, after removal of the water, that the ice in the iron vessel in which the hailstones had been collected, consisted chiefly of very regular convex lenses, 10 to 12 millimetres in breadth, and 5 to 6 millimetres in thickness. These lenses were, to a great extent, freed from bubbles and chinks, and were as clear as ordinary magnifying glasses. The nucleus of the original spheroid was either quite clear or still slightly opalescent. There remained no trace of the radial, spoke-like lines springing from the central nucleus.

The water which remained on melting the hailstones left, on evaporation, no trace of solid matters, even on examination with a strong magnifying power.

A similar hailstorm is recorded as having taken place at Marienfeld, to the east of Tiflis, on September 12th, 1863. The spherical hailstones, however, were covered merely with needles and teeth of ice, and not by any means with regularly developed crystals.

The observer, Herr Abich, makes no attempt to account for the remarkable and, as we believe, very exceptional phenomena which he describes.

THE "EGYPTIAN" ARGUMENT.

AS regards the great doctrine of Organic Evolution we are apt to fall into two mistakes. The first is, to suppose that the antagonist hypothesis of plants and animals having been at some time specially or mechanically created, each as we now see it, is of very remote antiquity. Far from it: the philosophers, the naturalists, and the divines of antiquity and of the middle ages gave it no countenance. The Talmud contains Evolutionist utterances. Bacon and St. Thomas Aquinas alike withhold their sanction from the "mud-pie theory of life," as Professor Le Conte happily expresses it. In short, what is sometimes known as the "Old Natural History" dates no further back than the seventeenth century, and is, perhaps, mainly due to John Milton and John Ray.

The second mistake is that of believing that no further discussion on the origin of species is necessary. It is perfectly true that, in the opinion of the best qualified judges, Evolution is "victorious all along the line." But, not to speak of writers and orators who have not had the necessary biological training, there are, especially in France, still certain "survivals," whose prejudices will not allow them to judge impartially, and who think that what Cuvier and his followers said, and what the Academy of Science accepted as truth, must never be called in question. These "survivals" from time to time bring forward afresh the old, refuted fallacies in a new form. Literary or political papers, thinking that a member of the Academy cannot be wrong, insert abridged extracts from their books, and so the general public is deceived.

In a work of this kind which has lately appeared we find a repetition of one of the most plausible, but most fallacious arguments in support of the permanence and the immutability of animal and vegetable species.

Everyone knows that when the first Napoleon undertook his expedition to Egypt he took with him a number of learned men, who were to study the country, its monuments, and its products from every conceivable point of view. Among their results was a series of observations of the birds and mammals sculptured on the most ancient monuments or actually preserved in the state of mummies. These images and remains were compared by Flourens with their living representatives as existing in our own days; a very close resemblance, or perhaps even a complete identity, was recognised and proclaimed. The sacred ibis of our century might have served for the original of the reliefs of his ancestors, carved out perhaps three, possibly four or five thousand years ago. Hence the inference was drawn by Cuvier and his disciples, and formally accepted by the official school of French biologists, among whom it survives to this day.

But this contention involves certain assumptions which are no part of the Evolutionist views. No follower of Darwin, of Lamarck, of Huxley, or of Haeckel has ever asserted that the modification of species constantly proceeds at all times, in all climates, in all forms of living beings, and at a uniform rate. The Cuvierians impute this erroneous belief to Evolutionists. They take for granted that because a certain phenomenon cannot be shown to have happened in one given locality, and within certain limits of time, it can never have happened at all. They assume that the lapse of three or even five thousand years gives scope to decide the question. They forget that in Egypt the climate and other outward circumstances have undergone no appreciable change within historical ages, and that there has thus been no inducement for modifications in the animals.

These considerations entitle us surely to dismiss the "Egyptian argument" as inconclusive. But there is an additional point, not as yet sufficiently noticed, which reduces the argument to a complete absurdity. If we make a careful examination of the oldest existing monuments we find there portrayed men of different races; or, if the term is preferred, varieties possessing the very same distinctive features which we observe in their descendants in our times. The negro is depicted as we find him to-day, the interval of 4,000 or 5,000 years having failed to modify his structural characteristics.

If, therefore, fixity of type for a few thousand years proves that certain animal species—say the sheep and the goat respectively,or the horse and the ass—are immutable and primordially distinct, surely the same conclusion must be extended to the races of mankind, and, *e.g.*, the Negro, the Arab, and the Jew must have had each a distinct and independent origin. The Cuvier-Flourens argument, if it proves anything, proves too much!

Similar observations may be made on varieties, strains, or breeds of domestic animals. The ram depicted on the old Egyptian monuments is identical with the ram of modern Nubia, and is neither more or less unlike other breeds of domestic sheep. Or, if we turn to a very different climate, we find that the small horse of the Lithuanian peasantry is the same whose skeleton is found in ancient tumuli and bone-heaps.

The Cuvierians are therefore in this dilemma: either they must own that the Egyptian argument is utterly null and void, or they must admit that it proves the absolute distinctness and fixity of races, varieties and breeds. But this latter alternative is fatal to them since they hold that there is an utter distinction between races and species, the former being mutable and the latter immutable. They regard the Negro as of one species with the European, and as descended from the same first parents. Yet if 5,000 years have failed either to approximate him to the white man or to take him to a greater relative distance, with what show of consistency can they expect that 5,000 years should perceptibly modify the relations between species? Yet with such arguments a Blanchard can seek to defend the decaying doctrine of mechanical creation!

METALISING WOOD.—A process by which wood is made to assume some of the special characteristics of metal is, according to *The Building World*, being now turned to practical account in Germany. By this process, which has produced some remarkable results, the surface becomes so hard and smooth as to be susceptible of a high polish, and may be treated with a burnisher of either glass or porcelain; the appearance of the wood being then in every respect that of polished metal, having, in fact, the semblance of a metallic mirror, but with this peculiar and advantageous difference, namely, that, unlike metal, it is unaffected by moisture. To reach this result the wood is steeped in a bath of caustic alkali for two or three days, according to its degree of permeability, at a temperature of between 164° and 197° Fahr. It is then placed in a second bath of hydrosulphide of calcium, to which a concentrated solution of sulphur is added, after some twenty-four or thirty-six hours. The third bath is one of acetate of lead, at a temperature of from 95° to 120° Fah., and in this latter the wood is allowed to remain from thirty to fifty hours. After being subjected to a thorough drying it is in a condition for being polished with lead, tin, or zinc, as may be desired, finishing the process with a burnisher, when the wood apparently becomes a piece of shining metal.

General Notes.

Specific Gravity of the Earth.—The mean value now accepted *(Journal du Ciel)*, is 5·56, a figure differing very little from that found by a number of experimentalists.

Specific Character of Poisons.—The fungus *Mucor imperceptibilis* flourishes in arsenical solutions, as does also a species closely allied to *Leptomitus*. The mould *Aspergillus niger* perishes in water containing $\frac{1}{100000}$ of nitrate of silver, but it cannot live unless zinc is present to the extent of at least one fifty-thousandth.

Peat as Fuel.—The peat of the North of England, Scotland, and especially that of Ireland, is free from sulphur, and hence, if dried and compressed, will prove an excellent fuel for iron-smelting, etc. The peat of Berkshire and Hants, on the contrary, is full of minute particles of iron pyrites, which render it quite unfit for fuel.

The Compounds of Ruthenium.—M.M. Debray and Joly describe, in the *Comptes Rendus*, the rutheniates and the heptaruthenates, which correspond in their composition respectively to the manganates and the permanganates. Nevertheless there is no true isomorphism between the compounds of ruthenium and those of manganese.

Discovery of Gold in France.—M. Mingaud, the geologist, whose researches in the Department of the Gard have proved of so much advantage to that district, has just discovered a vein of gold on white quartz in the Cevennes. He has duly informed the local Mayor, the Prefect, and the Minister of Public Works of the fact, and has presented some specimens to these functionaries as testimony of his latest success.

Waterspout in Yorkshire.—Another destructive waterspout is reported from East Yorkshire, considerable damage being done to a field in the occupation of Mr. Farthing, of Towthorpe, where it descended. As in the case of the Langtoft waterspout it denuded the field of soil and spoilt the crop of roots. The ponds were filled up with solid earth, a fence was uprooted, and other mischief done. The area of destruction was, however, more limited in this instance.

Tobacco Juice in Agriculture.—According to *Cosmos* the juice produced on steeping and macerating tobacco at the State manufactories is successfully used for destroying aphides, red-spider, and other insects injurious to vegetation. The juice is let down with water to about 1 deg. Tw., and applied to the plants in the evening. The next morning they are drenched with pure water. For fumigating hot-houses, etc., the undiluted juice is poured upon hot bricks and iron plates.

Curious Poisoning Case.—The *Semaine Médicale* and *Cosmos* report a case of poisoning which extended to a considerable number of persons at Hyères, above 350. It was at first supposed to be an epidemic, and received the name of infectious influenza. At last it was found that the sole cause was the wine supplied from a certain establishment, which, on analysis, was found to contain a notable amount of arsenic. We can scarcely suspect criminal intention, but there must have occurred lamentable carelessness.

Origin of the Aurora Borealis.—M. Luvini (*Comptes Rendus*) maintains that the friction of the particles of water and of ice, and, incidentally, of other substances, carried into the upper regions of the air by atmospheric movements is the source of the electricity of the air, of storms, and of the aurora. The discharges of this electricity take place in the same manner in auroras and in storms, the sole difference being the degree of intensity. The light of the aurora originates in such discharges in rarefied air.

Psycho-Physiological Action of Light.—A Dr. Cook, speaking on the effects of light upon living beings, stated that if a melancholy madman is placed in a room to which only red light is admitted, he becomes furious, whilst if a patient suffering from the raging type of insanity is kept in violet light, his affection is toned down to melancholy. This reminds us of the proposal of General Pleasanton, some years ago, who thought that both plants and animals could be rendered more healthy and vigorous by a sojourn in blue light.

Determination of the Electromotive Action of the Heart.—M. A. D. Waller (*Comptes Rendus*) finds that the electric variation which precedes and accompanies the ventricular systole may be demonstrated both in man and in the lower mammalia by means of Lippmann's capillary electrometer. This variation has two phases comprising: (1) A first stage at the beginning of the contraction, showing a negative condition at the point, that is to say an exciting change arising in this portion of the heart; (2) a second stage towards the end of the contraction of the ventricle, showing a negative condition of the base, that is an exciting change terminating in this part.

Fossil Grove at Whiteinch, near Glasgow.—According to the *North British Mail*, a most interesting geological discovery has been made at Whiteinch, in an old quarry now in course of conversion into a public park. The workmen have come upon no fewer than nine fossil trees, perfectly rooted and with erect stems. The stumps vary in circumference from 5 ft. 3 ins. to 11 ft. 4 ins. They vary in height from 1 ft. to 3 ft., and all have been broken off where the schist ends and the sandstone begins. Another tree, lying horizontally, is about 4 ft. in diameter. Whether they are *Sigillariæ* or Lepidodendrons seems undecided. It is concluded that they must have been covered with 3,000 ft. of strata, which was then reduced to a few feet by denudation. Millions of years must have sped over since these trees grew in a world as yet devoid not merely of animal life, but of the higher plant-forms.

National Fish Culture.—Further presentations of trout fry have been made this year by the council of the National Fish Culture Association to the rivers Lea and Colne, and also to the public waters of Maidstone,

Canterbury, Portsmouth, Nottingham, Stamford, and Northampton. The hatching season of this year has been attended with most satisfactory results. The ova laid down were taken by Mr. W. Oldham Chambers, the Secretary, from stock-fish in the ponds of the Association at Delaford Park, and these were supplemented by consignments of valuable ova forwarded by the United States Fish Commissioners, being those of the rainbow trout, lake trout, and brook char indigenous to Transatlantic waters. These were incubated with a very low mortality, and the result is a plentiful yield of fry which, owing to the prevailing lowness of the temperature during the winter, are strong and healthy examples of trout. There is a large quantity of yearling and three-year-old rainbow trout in the ponds, the latter being spawned this year for the first time.

A Narrow Escape.—An accident occasioned by a cause perfectly unforeseen, but which fortunately has not led to disastrous results, has just taken place, says *La Nature*, at the powder mills of St. Médard, near Bordeaux. The works, which cover a large surface, are lighted at night by six lamps with a Piper regulator. These lamps, which are supplied by a dynamo, yielding 50 to 60 ampères are mounted in tension, two by two. At one of these lamps there was intercalated a resistance of about 28 ohms, inclosed in a square wooden box, placed at the height of four yards from the ground, upon the post supporting one of the lamps. In two of the sides of the box there had been left holes of the form of a trefoil. It seems that a tom-tit, in quest of a secure and comfortable place for its nest, fastened straws and twigs to the German silver wires forming the resistance. At the moment of the passage of the current, the wires were heated to such a degree that they ignited the dry materials of the nest. Thence the fire spread to the box, which fell blazing upon the damp soil, and was soon extinct. But what might have happened if the ground had been dry, and if the fire had spread among withered grass to the buildings containing explosible matters? One of those strange catastrophes which all manner of scientific men vainly strive to account for.

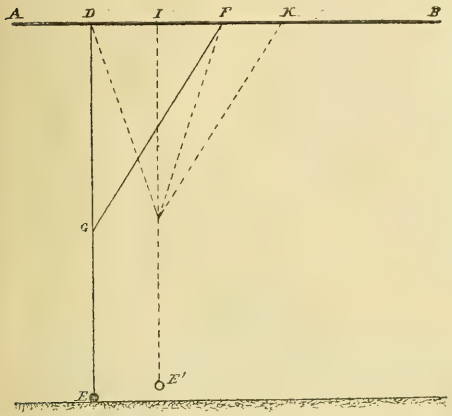
Scientific Exploration off the Irish Coasts.—An expedition sailed from Queenstown on May 26th on board the tug *Flying Falcon*, in order to examine on the south and south-west coasts of Ireland the fishes and other marine animals down to 1,000 fathoms, and returned to Queenstown on June 2nd. In one spot the deep trawl, shot with 1,270 fathoms of steel wire rope, brought up, among other interesting creatures, a black fish with white eyes. After dredging had terminated the various specimens secured were examined, which showed, besides some very strange deep-sea fish, several specimens of that strange genus of echinoderms *Calveria*, a few silicious sponges, and the rare and beautiful *Cassideria tyrhena*, and some large and exquisitely coloured sea anemones; also a quantity of *Carinaria* and *Pteropoda*, which were captured in surface nets. Mr. Day photographed the animals, and Mr. Kane with his brush secured the bright colours which vanish quickly from the specimens. Mr. Sladen, of London, will examine the echinoderms. Professor Solas, Trinity College, will examine the sponges, and Mr. Wright, of Belfast, will examine the foraminifera, after which the specimens will be forwarded to the Royal Irish Academy and the Science and Art Museum.

Waterspouts.—We learn from the "Pilot Chart of the North Atlantic," issued by the American Hydrographic Office, that on April 10th, in latitude 40° 59′ N., longtitude 47° 30′ W., a large waterspout, accompanied by several smaller ones, formed to the southward of the British steamship *Pavonia*, Captain McKay, and travelled to the N.-E. at a rate of about thirty miles an hour. The vessel's course was changed to avoid it. As it passed, the whirling rush of air was felt on board. The great column of water reached up to a dense, black, low-lying cloud, and was in shape like a huge hour-glass. It was accompanied by a terrific roaring, and the water at its base was churned into a mass of foam, causing such a commotion that it made the great ocean steamship tremble. When off the starboard bow, the spout broke, with vivid lightning, heavy thunder, and a deluge of rain and hail. Many pieces of ice fell on deck; they were irregular in shape, some of them from 4 to 6 ins. in diameter, looking, as the captain expressed it, as if chopped off a large block. On the afternoon of the following day, and in a position about 250 miles N.-E. from that of the *Pavonia*, Captain Wills, of the *British Queen*, reports seeing three distinct spouts at the same time—one to the N., one to the S.-W., and one about S.S.-E. The one observed most carefully commenced with the formation of three small inverted cones, projecting downwards from the clouds. These gradually merged into one, which increased rapidly in size, with a white centre visible throughout its length, and seemed to grow downwards until it reached the surface, where it caused a great commotion. At first its axis was nearly up and down, but soon became very strongly curved to the westward at about the middle of its length, owing, probably, to the varying currents of air. Its diameter gradually decreased until it died away in the distance, a fine sinuous line reaching from the clouds to the surface of the water. It also appears that seven pronounced cyclonic storms passed over portions of the North Atlantic during the past month, but none traversed the entire ocean.

A Thunderstorm on the Top of Ben Nevis.—Mr. R. F. Omond, Superintendent of Ben Nevis Observatory, in his report on the weather for May, says:—On the evening of the 18th temperature began to rise rapidly, and it continued high—over 40°—all the 19th, on the afternoon of which day a severe thunderstorm passed over the hill top. A south-west gale of about sixty miles an hour was blowing at the time, and the thunder clouds coming rapidly up over the hills to the south-east at about the level of Ben Nevis struck the top, enveloping it in mist, and pouring down heavy rain. As each cloud came on, the lightning, though vivid, was not very frequent; but as the cloud left the hill top a slight shock was always felt in the observatory, a sharp report being heard in the lightning conductor, and occasionally sparks springing out from the stoves and other large pieces of iron in the building. A slight fall of temperature the day after this storm was quickly followed by a rise, and from the 21st to the 26th was the period of finest weather in the month—the barometer and temperature were both high, the air dry, the sky nearly cloudless, and the winds light. During these six days over two-thirds of the whole sunshine of the month was recorded. The last five days of the month, however, have been colder and rather stormy, heavy showers of snow falling, with strong, squally winds.

INTELLIGENCE OF INSECTS.

MR. ROMANES, in a recent lecture at the Royal Institution, pointed out the intellectual power displayed by insects; they rank sometimes higher than some mammalia in this respect. He had received a communication from Mr. Langley, one of the first astronomers in America, with reference to a spider which had dropped a fly, that it had killed, from the bar of a window to the ground; the fly was too heavy to be lifted in an ordinary way, and the spider had to devise some cunning method of doing it. Analogous to lifting a fly, we may suppose ourselves to have to lift a heavy ox up a high cliff with nothing at hand but unlimitable rope; how should we do it? Mr. Romanes stated that he had given a problem to two senior wranglers, both of whom failed to solve it. The spider's device, however, was simple, like most inspirations of genius, and the following diagram is an attempt to show its method of procedure, though it is difficult to demonstrate it clearly without the aid of a blackboard on which to erase the lines after the manner of the spider in proceeding with



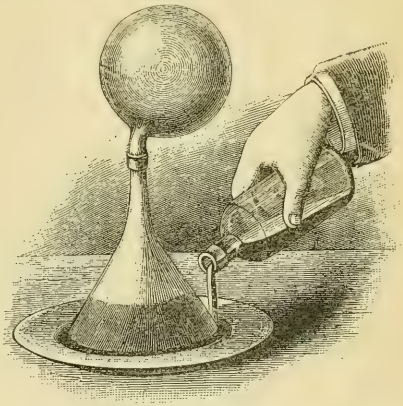
its work. Let AB represent the window bars from which the fly has fallen, and B the place where the spider wishes to deposit the fly. Let E, be the fly on the ground. The spider walked as far as D, just above the fly, and dropped a line, attaching the fly to it. Then it retired to the position F, and dropped a guy-line GF; next it drew up the guy-line so as to draw the main line DE into a loop as indicated by the dotted line, and fastened the guy-line thus drawn up at F. Now it proceeded to the point I, just above where the fly was in its altered position, and again dropped a vertical line, and then another guy-line from K to the new vertical line IE'. It then hauled on the new guy, and fastened it at K, and as soon as this was done it destroyed the lines DE and FG, which were no longer of use. In this way the spider continued to drop a series of vertical and guy-lines until, and by degrees the fly was finally hoisted into the required position.

A NEW SPECIES OF FISH.—M. Victor Fatio *(Comptes Rendus)* has discovered a new species of fish in the lake of Bourget. It belongs to the *Salmonidæ*.

EXPERIMENTS IN CAPILLARY ATTRACTION.

FEW subjects are so fertile in simple experiments, requiring little or no special apparatus, as capillary attraction. Faraday, who was unrivalled as a popular lecturer, continually employed the simplest possible method of illustrating the action of this subtle force. One of the most striking he performed thus: A pile of salt was placed upon a plate. The lecturer then poured into the plate a saturated solution of salt in water. The solution was coloured to make it easily visible. As it was poured about the base of the salt, it was drawn up through the pores existing between the grains. By the operation of capillary force the coloured solution gradually rose upwards, colouring the salt as it ascended.

The clue to the success of this experiment is in the use of the salt solution instead of plain water. Were the latter used, it would rapidly disintegrate the pile of salt, by dissolving it. With the saturated solution the solid salt is quite unaffected.



In the illustration is shown a modification or development of this experiment. The apparatus required is a little more extensive, as, in addition to the plate, a glass funnel and an india-rubber balloon are needed.

The balloon should be inflated to its largest size, and kept so for some time, so as to stretch the rubber well. This is to enable it to fill at low pressure. The glass funnel should be as large as possible, as the demonstration is more satisfactory when executed on a large scale.

The funnel is filled with perfectly dried salt well pulverised, which is pressed in as hard as possible. The funnel is completely filled with it, when supported mouth upward. The filling may be carried a little above the rim. The plate is then placed over its mouth so as to bear against the salt, and the whole is inverted. The object is to so conduct the operation that the salt shall not settle down or change its position, but shall remain in close contact with the wall of the funnel. All these precautions are quite essential to success.

The mouth of the balloon, whence the air has been expelled, is now sprung over the open end of the funnel, as shown in the cut. It is not necessary to tie it on. The balloon must, of course, be perfectly empty.

The plate, funnel, and balloon are now ready for the

experiment. A saturated solution of salt should have been prepared. This is made by shaking in a bottle an excess of salt with the water. As salt is more soluble in cold than in hot water, the operation must be done at ordinary temperatures. As colouring matter a little ferric salt with sulphocyanide of ammonium may be added, or any ink that is soluble in water may be used.

The solution is now poured into the plate so as to rise above the edge of the funnel and keep it immersed. It at once rises through the salt, colouring it as it ascends. As fast as it rises, it of course leaves the plate. Hence the experimenter must make repeated additions of solution. As the fluid rises it drives out the air before it. This would escape from the mouth of the funnel. But the balloon which has been placed there intercepts its escape. The air enters and rapidly inflates it. The pressure thus produced is slight. It cannot do more than just fill the balloon. It cannot distend it. But by having the balloon well stretched, its inflation can be made quite conspicuous.

If, by settling, the salt has left any space between itself and the wal's of the funnel, the possible pressure, slight at the best, will be greatly diminished. If the balloon exerts the least back pressure, air will bubble out of the weak spots around the rim of the funnel.

By substituting for the salt a cone of porous clay, a more permanent apparatus could be readily constructed. —*Scientific American.*

NEW METHOD OF NATURE PRINTING.

A FEW years ago, Mr. Horace M. Engle devised a method, which he has recently published in the *Botanical Gazette*, of taking very beautiful leaf prints.

The requisites for the work are : 1. A small ink roller, such as printers use for inking type. 2. A quantity of green printer's ink. 3. A pane of stout window glass (the larger the better), fastened securely to an evenly planed board twice the size of the glass. A small quantity of the ink is put on the glass and spread with a knife, after which it is distributed evenly by going over in all directions with the ink roller. When this has been carefully done, the leaf to be copied is laid on a piece of waste paper, and inked by applying the roller once or twice with moderate pressure. This leaves a film of ink on the veins and net-work of the leaf, and by placing it on a piece of blank paper and applying considerable pressure for a few moments, the work is done, and when the leaf is lifted from the paper, the impress remains with all its delicate tracery, faithful in colour and outline to the original.

To get the best results, however, several points must be carefully noted. The ink, as sold, is invariably too thick for this purpose, and should be thinned by adding several drops of balsam copaiba to as much ink as may be taken on a salt spoon.

Much depends on the proper consistency of the ink. In inking, the leaf is apt to curl on the roller, but it should part readily from it. In case it sticks tightly, the ink is too thick. Take care that the ink is evenly distributed on the glass and roller, as it is essential that each part of the leaf receives an equal coating of ink. If the leaf is large, ink it part by part, keeping the roller supplied frequently. A roller three inches long will answer for all small leaves and branches of plants. If the leaf is finely veined, the lower surface makes the better print, but if the veins are coarse and large, the upper surface may be used. If the specimen be fleshy or brittle, allow it to wilt until it becomes more pliable, or, if necessary, it may be pressed and dried first. In most cases the best copy is obtained after taking one or two impressions, as the leaf takes the ink better after several applications. A good quality of unsized paper that is made slightly damp by putting in a cellar several hours before using is best for general work, but in other cases well-sized paper will take a copy that will allow an impression to bear inspection side by side with a good lithograph. A copying press will be found very valuable in making the impression, especially if the leaf is at all coriaceous. If it be soft, it should be covered with a few thicknesses of newspaper. If it be irregular in thickness, paper may he laid over the thin parts, so that equal pressure is received. This is necessary with all leaves that have thick stems. If the leaf or branch be very irregular or delicate, or in the absence of a press of any kind, the specimen may be covered with several layers of paper, and held in place with one hand while the pressure is applied with the thumb or palm of the other hand.

For illustrating monographs and similar papers where the number is too limited to warrant an expensive lithograph, for identifying a rare specimen, or as an adjunct to an herbarium combining portability, unalterability, and beauty withal, the method seems particularly fitted. But aside from this, others may find a delightful and instructive recreation in taking prints of the entire flora of an old farm, the trees of a certain grove, the native animals of a county, the ferns of a state, or any other special field that seems most inviting. Such copies may be taken in a blank book suited to the purpose, or better, taken on single sheets of uniform size, as in this way imperfect copies may be thrown out, and when the work is completed, named, classified, and bound, thus making a volume of real value.

MAGNESIUM.—The following experiments were made for the aluminum and magnesium manufactory in Bremen, at the mechanical experimental station in Charlottenburg. Tensile strength, limit of breaking, 23.2 kilos per 1 sq. mm., specific resistance to compression 27.2 kilos per 1 sq. mm., bending strength 17.4 kilos. In comparison with other metals, the strength of magnesium is relatively very considerable. The breaking coefficient for tensile strain per square millimetre is :

	Kilos.	Specific Gravity.
Magnesium	23.2	1.75
Aluminum	20.5	2.67
Brass	12.5	7.8-95
Bronze	23.0	8-9
Rod iron	38.0	7.6-7.8
Delta metal, poured in sand	34-36	8.6
Delta metal, rolled hard	53.0	—

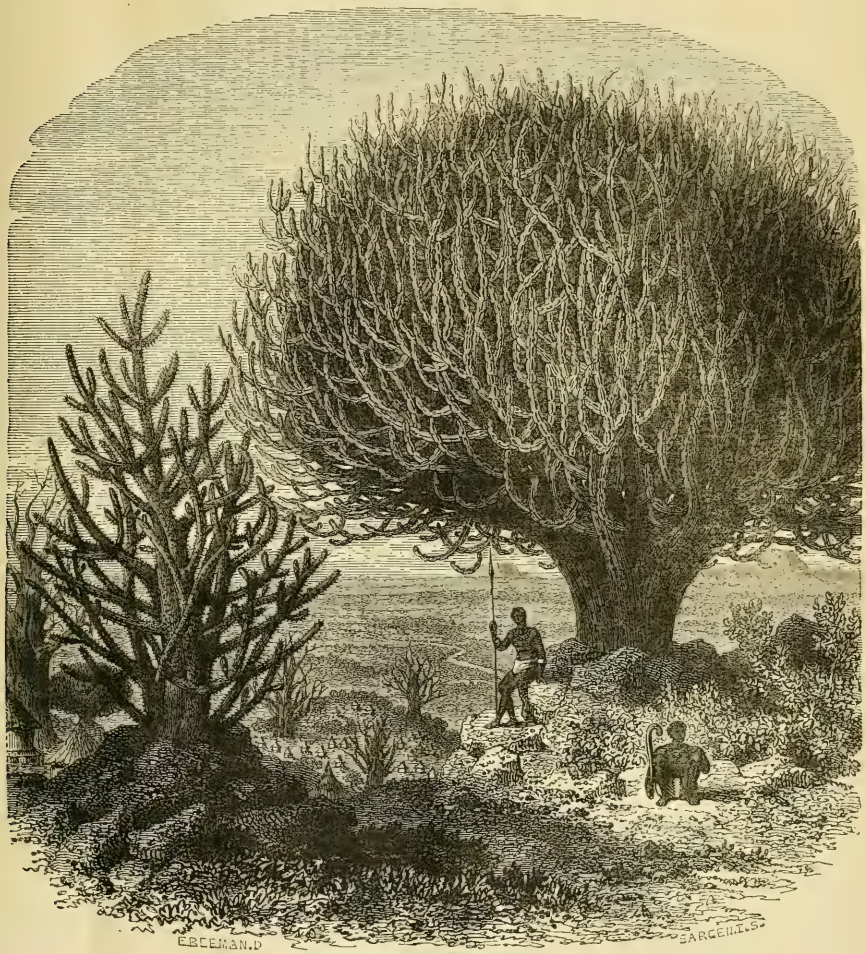
Since the rolling of magnesium does not offer the slightest difficulty, even in such complicated forms as T I U, or as angles, round or four-cornered rods, plates or sheets of 0.1 mm. thickness, and as pure magnesium is sufficiently resistant to atmospheric influences and can be polished and easily cleaned, it lends itself on account of its lightness and relative strength to the construction of apparatus, etc., required to be made of metal and also to be light, as, for instance, nautical, physical, and astronomical instruments. The working of magnesium requires heat. At a temperature of 450° C. it can be rolled, pressed, worked, and brought into complicated forms. Screws and threads can be made of magnesium, and these are considerably sharper and more exact than those from aluminum. Owing to its cheapness, magnesium can also be used in the manufacture of a variety of useful articles. Experiments in this direction are now being made.—*Jour. Soc. Chem. Industry.*

Natural History.

ARBORESCENT EUPHORBIA.

We borrow here from *Cosmos* a figure and a description of a gigantic African Euphorbia. Physicians give the name "euphorbia" to a very irritating resin secreted by three cactus-like trees, *Euphorbia antiquorum*, *E. officinarum*, and *E. Canariensis*. These trees grow, the first-mentioned in India, the second in the deserts of Africa, and the third in the Canary Islands. Botanists reserve the name euphorbia for the plants which yield this resin. To put an end to this confusion certain pharmacological authorities propose to call the drug *Euphorbium*.

The juice, or the resin, of the euphorbia possesses remarkably irritating properties, which have long been known and employed in medicine. Euphorbius, the physician of Juba, King of Mauritania, seems to have been one of the first to make use of it, whence the drug bears his name. The inhabitants of Central Africa employ it as a poison to destroy their enemies. They make incisions in the stem of the tree, from which flows a milky juice. In this juice, after certain manipulations, which serve to concentrate the liquid, they steep the point or the edge of the weapon which they wish to



envenom. There are in their regions two species of euphorbia, one of which, *E. Canariensis*, is represented in our figure.

This is a tree of an extraordinary size, contrasting strongly with specimens of the same plant growing in our hothouses. It has been sketched by M. Trémeaux, at Kaçane, and the learned traveller relates in his 'Journey to the Eastern Soudan" that it inspires the negroes with a superstitious dread. Still, as these trees yield a cool shade by reason of their evergreen branches, the natives love to come to them for shelter, taking care, however, to construct a horizontal thatched roof beneath the shade of those which they commonly frequent.

M. Trémeaux relates that he had much trouble to induce the native who accompanied him to sit under the shade of the tree, and when he broke off a branch the native fled, giving signs of real terror. The juice which flows down in such cases is, in fact, very irritating if it touches the bare skin.

The euphorbium of commerce comes chiefly from Mogodor. To collect it incisions are made in the stems, and the sap which flows down condenses in small lumps which adhere to the base of the thorns. It is found in small rounded tears, generally pierced by conical holes, the marks of the thorns. It is a most violent irritant, and is rarely used except externally and mixed with other vesicants. Nevertheless the Arabs use it in a mixture which they employ internally for the bites of serpents and rabid animals. It is remarkable that most of the popular specifics for animal poisons contain very irritating principles, *e.g.*, not merely the juices of the *Euphorbiaceæ*, but *Cantharides* and other insects of the same family.

Various euphorbiaceous plants are found in Europe. One of them, a biennial plant, is sometimes used by practical jokers. They advise any one who wishes to rise early to rub his eyes with the juice of this herb. This is a very original alarum, as it prevents the person from sleeping by reason of the pimples which it produces on the eyelids, which itch frightfully. A more sensible use of this juice is to destroy warts, which, if rubbed with it, disappear in a few days.

The leaves of the spurge, *Euphorbia lathyris*, which grows wild in Europe, are used by poachers as a poison for fishes. The beautiful hawk-moth, *Deilephila euphorbiæ*, rare in England, though common in some parts of the Continent, feeds upon this plant and certain nearly allied species.

Sieve Tubes.—In a paper on the obliteration of sieve tubes in the Laminariæ, published in the *Annals of Botany*, Mr. F. W. Oliver gives it as his opinion that the callus or thickening of the sieve plates in plants is formed, as suggested by Wilhelm and Janczewski, by an alteration of the cell wall, and not from the contents of the cell. Although in the foreign genera Macrocystis and Nereocystis true sieve tubes very like those of Cucurbita are met with, yet in the majority of the Laminariæ sieve tubes are represented only by narrow tubes known as trumpet-shaped hyphae, in which the callus extends up the sides of the cell wall, and is not restricted to a thin plate-like form. Mr. Oliver has been fortunate enough to meet with an instance in which the mode of formation of the callus is shown in different stages of development, the walls of the tubes presenting callous degeneration at intervals. The callus of Laminaria was found to agree with that of flowering plants in its microchemical reactions, and may be regarded as chemically the same substance.—*Scientific American.*

Weaver Birds and their Nests.—A correspondent of *Nature* saw some nests of the weaver bird fixed on the telegraph wires. He writes:—While watching the landscape of Natal, between Ladysmith and Pietermaritzburg, I saw some nests of the "golden weaver" bird. There were four of them hanging in a row, close together. They were the round kind, without the long arm. On one of the nests sat a cock weaver bird, but I saw no hens. The nests seemed to be one or two years old, except one, which was greener than the others. The chief peculiarity seemed to lie in the fact that the birds had woven grass round the wire for some six or eight inches, and two or three inches in circumference, before beginning to make the nest, and had to deal with a horizontal wire instead of a vertical stick or a branch. The bird always twists the grass round the branch (if he builds on a vertical twig) for some way up among the leaves and stalks, leaving the long ends free, thus forming his foundation. Weavers prefer to build on trees where the long slender twigs droop towards the ground, and so afford a nice vertical slender support. They are especially fond of the weeping willow, whose slender switches generally branch off into two small shoots at the end; between these the bird loves to build his nest. Besides, the willow has lots of leaves very near together, and so holds the straws very well. On the wire he had no such support, but had to trust to his own ingenuity to overcome the novel situation, which task he seems to have accomplished very well. The entrance to these nests was not at the bottom, as usual, but by a hole in the side, and all the nests did not look the same way.

Spread of the Starling.—According to Mr. H. Kerr (*Newcastle Weekly Chronicle*) the starling was comparatively rare in the Northen Counties a quarter of a century ago, and was unknown in the South of Scotland. Now it is plentiful in the Northern Counties, and over Scotland as far as Sutherland.

Sense of Beauty in Birds.—According to W. R. O. G. *(Field)* the gardener bird (Amblyornis, discovered by Beccari, in New Guinea) surpasses its kinsman the bower-bird, in the elaborate ornamentation of its gallery. The roof is formed of the still living branches of an orchid (*Dendrobium*). Around this dwelling they lay out a tiny lawn of soft moss, carefully freed from weeds and stones. On this lawn they spread out flowers, fruits, brilliant insects, etc., which they constantly replace if they fade. The birds are of the size of a thrush, and are mostly of a brown colour, but in one species the male has a splendid golden-orange crest.

The Food of the Sardine.—M. A. F. Marion recently stated, at a meeting of the Academy of Sciences, that on the coasts of Provence and elsewhere the sardine feeds on various pelagic invertebrates. Various Copepods, especially species of *Cyclops*, *Oithona*, *Thalestris mysis* and *Thalestris robusta*, are found in the digestive organs of the fish, especially in spring. Fragments of *Podon* and of *Radiolaria* are also found.

Anomalous Egg.—Mr. W. B. Cousins, of Constant House Collegiate Schools, writes to a suburban paper that he has in his possession a "double soft egg," which

was laid by a "Plymouth Rock," on May 22nd. The two parts are joined by a stout band at the ends, and in one is the yolk entire and in the other the white. This specimen is to be seen at No. 71, Regina Road, N.

Weapons of Insects.—Dr. Lampert gives in *Humboldt* a summary of the means employed by insects in repelling their enemies. Interesting facts have been elicited concerning the stings and hairs, the latter of which are so common among lepidopterous larvae, and which often exert an injurious action upon the human skin. Many of the hairs have barbs; some, especially the smaller, bore perpendicularly with their fine points into the skin, and are driven deeper by any pressure or contact applied above. At the same time a chemical irritant adhering to the hairs contributes to the inflammation of the injured part. The excretion of a liquid product is very common as a protective. The "cuckoo-spit," in which the larvae of *Aphrophora spumaria* is concealed, is well known. It is curious that this secretion in different countries is ascribed to the cuckoo. In other cases we notice the emission of a secretion in case of need, generally a corrosive or offensive liquid. Every collector of insects knows the secretions of the Carabs, of Melœ, of Coccinella, of Cychrus, and of the puss-moth. Nor must we overlook the characteristic odours of the goat-moth, caterpillar, or of the larva of *Lina populi*. The latter is very economical, for as soon as the danger is over it draws back into its body the whitish, intensely smelling drop which oozes from every tubercle. The power of the *Brachini*, bombardier beetles, to project a blue vapour against an enemy is well known. In *Cerapterus 4-maculatus*, a member of the exotic *Paussidae*, this vapour is found to contain free iodine (see *Tijdschrift d. Nederl. Dierkund Vereeniging*, 2 ser., Decl. 1, 1887, 106-108). In cases where we see insects shunned by insect-feeders, though no protective agent is known, they have probably a disagreeable taste. Seitz mentions that butterflies are distinctly shunned by birds.

Insect Pests.—We have already mentioned the plague of caterpillars now experienced in, and near Epping Forest, and extending to Hadley and Highgate Woods, and other localities where oaks abound. The chief offenders are the caterpillars of *Hybernia defoliaria* and of *Chimatobia brumata*. The former species, known to some English collectors as the "Mottled Umber," may now be seen dangling from the branches of the oaks literally in myriads. The second species, the "Winter Moth," is less given to dangling, but it spins two or three leaves together with silk. It attacks most kinds of fruit-trees, apples, pears, and plums, and does not disdain standard roses. As regards the enemies of these depredators, the starlings and tom-tits seem the most active. Upon sparrows we place no reliance, knowing that they eat caterpillars only in default of something more to their taste. Ichneumons seem this season not very plentiful, but good service is being done by the carnivorous caterpillar of *Cosmia trapezina*, sometimes known as the "Dun-bar." This caterpillar is found on the oak and the horn-beam, and may to some extent feed on the leaves, but it evidently prefers animal food. In chasing and capturing other caterpillars it shows an address and pertinacity which speak of hereditary predaceous habits.

THE AUSTRALIAN MAMMALS.

THERE must be few zoologists who have not been greatly struck by the very singular manner in which so many of the Australian mammals reproduce, as it were, various characteristics of those which not only inhabit other continents, but which also belong to totally different orders. All the indigenous mammals of Australia are marsupials; that is, the female animals are furnished with a peculiar pouch, formed by a fold in the skin, in which they carry their young for a considerable time after birth, and in the walls of which the teats are situated. This structure is necessitated by the fact that these young, in many cases, are born while little more than mere embryos (the kangaroo itself is only an inch long at birth), so that protection during the early stages of their growth is absolutely essential, while at the same time they must be almost continuously nourished by their mother's milk. Hence they are placed in the marsupial pouch as soon as they enter the world, and there they remain, it may be, for six or eight months, leaving it occasionally for a short time towards the end of that period, but always returning to it when danger threatens or hunger assails. And this structure it is which forms the distinguishing feature of the group.

Of the three animals which do not appear to possess it, and which are yet found in a wild state on the Australian continent, one—the dingo—has almost certainly been introduced from elsewhere, while the porcupine ant-eater and the duckbill are now admitted to constitute a "sub-order," traces of the marsupial structure being distinguishable when carefully looked for. In all others it is conspicuous enough, although not in every case sufficiently developed to serve as a receptacle for the young.

With the sole exception of the opossums, which are natives of the New World, these marsupial animals are strictly confined to Australia and the neighbouring islands. No marsupials are found in other parts of the world; no mammals belonging to other parts of the world are found in Australia. This, the smallest of the continents, has neither monkeys, bats, carnivora, insectivora, rodents, nor ungulates. Pachyderms are unknown; edentates do not exist. And yet representatives, so to speak, of most of these groups are found among the marsupials themselves, feeble imitations, as it were, of stronger species belonging to the higher divisions, so that the marsupial order forms a sort of epitome of Old and New World mammals upon a reduced scale, the resemblances being so perfect that they cannot be overlooked, while the presence of the characteristic pouch debars us from referring any of the animals in question to the families to which otherwise they appear to belong.

Thus we have the dogs represented by the Tasmanian wolf, in which the peculiarities of teeth, limbs, and form distinguishing the Canidæ are faithfully reproduced; the bears by the Koala, or Australian bear; the squirrels by the Petaurists; the edentates by the Echidna: and so on. And, more remarkable still, in the Wellington caves of New South Wales the fossil bones of a marsupial lion have been found, and are now to be seen in the museum belonging to the Mines Department of Sydney. These bones, which consist principally of teeth and jaw-bones, were submitted to Professor Owen for examination before being sent for exhibition; and, according to his report, their owner was of true leonine

character, excepting, of course, as regards the marsupial structure, and was fully equal in size to the existing African species.

Similar discoveries have also been made in Victoria from post-pleiocene deposits; and it is worthy of note that, many years ago, Professor Owen, in commenting upon the herbivorous characteristics of the extinct Australian *diprotodon*, expressed a strong conviction that some large carnivoron must have been contemporary with it, in order to restrain its numbers within due bounds. Now that these remains have been found, no doubt whatever remains upon the subject, and we have certain testimony that at an earlier period of the world's history a lion-like mammal was numbered among the Australian *fauna*, and thus that the great and important family of the cats was represented by one of those feebler imitations of which, mimicking animals of different kinds, we find so many still existing.

The question naturally arises, How did these embryotic types, so to speak, originate, and how is it that they have risen no higher? Why are there not a cat tribe and a dog tribe in Australia, just as there are in other continents? Why does nature seem to have stopped short, so to speak, in the work of evolution in one part of the world, while carrying it on in another?

An answer, although, perhaps, not a perfectly conclusive one, is not far to seek.

We have, in the first place, to remember, as Mr. Darwin has shown us, that competition between different animals has much to answer for in the gradual evolving of the higher type from the lower. The fiercer and more incessant the struggle for existence, the more searching will be the natural selection appointing the individuals which are to survive. And the degree of this competition depends very largely upon the area which the animals in question inhabit. With an extended area comes a corresponding extension in the number both of species and of individuals, which must struggle for the mastery; with a limited area comes a corresponding diminution. And how important a factor is this in bringing about final results, no reader of the "Origin of Species" can be ignorant.

Now in the case of the Australian fauna the struggle for existence can never have been especially severe, owing to the small size of the continent, and also to the limited number of the animals which inhabit it. Of the three continents into which the land of our globe is divided —for Europe, Asia, and Africa are all one, just as North and South America are another—Australia is very much the least, and the competition between the animals to which she affords a home can at no time have been very keen. The largest and strongest animals of all we find in the largest continent; the smallest and weakest in the least. And America is midway between the two, producing a varied and extensive fauna, but without either the large and powerful species of the former, or the weak and feeble creatures of the latter. The elephant, the rhinoceros, the hippopotamus, the giraffe, the lion, the tiger, and the ostrich: all these are African or Asiatic. America is the home of the bison, the puma, the jaguar, and the rhea; smaller and less powerful. And in Australia we have nothing larger than the kangaroo and the emu, both of which are physically inferior to animals of equal size inhabiting the other continents.

Thus it would seem that the inferiority of the Australian mammals is largely due to the small size and the isolated position of their native land. They have not been compelled to pass through long periods of severe competition, and so have stood still while other animals have advanced, evolution being rendered a far more tedious process than if surrounding conditions had been more favourable. Not only that, their physical powers are less developed, their robustness and endurance less great, than in animals of lesser size, reared under circumstances more suitable for the development of constitutional vigour. Thus it is that such mammals, birds, and even plants, as we have introduced into Australia have carried all before them, and increased and multiplied to a degree which we never for a moment anticipated. The rabbit, the sparrow, the sweet-briar and the thistle, all these have broken bounds altogether, and are steadily pushing their way with resistless pertinacity towards the districts which they do not at present occupy. Their robust nature, tried and proved by many centuries of competition, enables them without difficulty to oust and overcome others which have not been subjected to an ordeal of equal severity, and thus it is that these introduced animals and plants continue their irresistible advance, overcoming and expelling others of greater size and apparently more perfect constitution.

As far as the strictly marsupial character of the Australian mammals is concerned, other causes have no doubt been at work, of which we know little or nothing, for it is not suggested that the quadrumana, carnivora, rodents, and ungulates of other parts of the world have sprung from similar parentage. But it is, to say the least, strongly suggestive to find, as it were, the germs of many of these orders among the marsupial mammals, and it is difficult to refrain from speculation upon the results which might have followed had these animals been placed from the first under conditions similar to those encompassing others. Probably they would have developed in very much the same degree; certainly they would have attained to forms very different from those in which we see them now. And more than this, in the present state of our knowledge, it is unfortunately quite impossible to say.

Reviews.

The Reason Why. London: Houlston and Sons. 1888.

This book professes to contain "a careful collection of many hundreds of reasons for things which, though generally believed, are imperfectly understood"; and on its title-page it bears, besides the above announcement and the imposing words GENERAL SCIENCE, an intimation that it has reached its fifty-third thousand. We are sincerely sorry to hear it, for we have never seen any work of the kind displaying more ignorance on the part of its compiler, or better calculated to give false and inaccurate ideas to its readers. This is a grave accusation, but we are quite prepared to substantiate it by extracts and references. On page 4 the reader is told that light, heat, and electricity are called "*imponderable elements*" because they "differ from other elements in being destitute of weight," and on the next page that "the imponderable" is "a state of matter," and that "there are various opinions as to whether light, heat, and electricity are *substances*." Chapter VI. takes us back to the dark ages in physics; therein we find "caloric" spoken of as being "*squeezed* or *forced out*" of bodies when struck against one another, and the inquirer is assured that if flint and steel were soft and yielding, "the caloric would simply

be *driven from one part of their substance to another.* Friction produces caloric because it "has a tendency *to flow towards a point of excitement.*" And more astounding still—"When water is poured upon quick-lime, the caloric *which caused the fluidity of the water is given off!*" In Chapter XVIII. a misplaced devotion to Final Causes leads the compiler to state that the radiation of heat from rough surfaces "exhibits the Divine wisdom" in that "it causes the deposition of dew upon grass, plants, and trees," while "upon barren rocks, etc., *where dew would be of no benefit*, it does not form." Unfortunately the stern logic of facts compels him to refer, on the next page, to the saturating of a sheep's back, in which no ingenuity can find a benevolent purpose. On page 115 there is the very queer remark that "there is as much heat in the body of a man as would, if it were compressed into a smaller space, cause *a bar of iron* of considerable size to become *red hot.*"

The chemistry of Chapter XXXIII. is like a bad dream. "Oxygen gas is oxygen rendered gaseous by caloric," and "*by itself* it is incombustible." Nitrogen is —*mirabile dictu!*—"the principal (*sic*) of *nitre* made gaseous by combination with caloric."

Have we now, we may ask, made good our charge? If not, surely we shall dispel any lingering doubt of its validity by referring to page 145, where the reader is told that "combustion is a chemical process by which certain substances *decompose oxygen gas*, absorb its base, and suffer its caloric to escape, producing heat!"

We may incidentally remark that the italics in our quotations are the compiler's own, and that in many instances he thus emphasizes, perhaps by way of defying modern science, the most glaring of his errors.

It is saddening to see a book like this—inaccurate, misleading, devoid of the scientific spirit—put in circulation as a competitor with, for instance, the admirable *First Year of Scientific Knowledge*, written by the late M. Paul Bert; more saddening still to reflect that many well-meaning people will buy it rather than this last, because they have not yet learned to be more anxious to seek truth than afraid of finding it.

A Catalogue of the Moths of India. Compiled by E. C Cates, First Assistant to the Superintendent, Indian Museum, and Colonel C. Swinhoe, F.L.S., F.E.S., F.Z.S., etc. Part I. "Sphinges." Calcutta: The Trustees of the Indian Museum.

Times have changed since Linnæus included all the known hawk-moths in the single genus Sphinx. We now find them raised to the rank of a family, the Sphingidæ, including 187 species found in India alone, and subdivided into the sub-families Macroglossinæ, Chærocampinæ, Ambulacinæ, Smerinthinæ, Acherontinæ and Sphinginæ, including no fewer than 35 genera.

An interesting fact concerning these hawk-moths is their very wide range. Owing to their great strength of wing and wonderful swiftness, they find little difficulty in crossing seas, deserts and mountain-ranges. They are also more versatile in the selection of food than most other moths and butterflies. Thus the beautiful "Oleander-hawk," *Daphnis Nerii*, which in Europe and around the Mediterranean feeds upon the oleander, and in case of need upon the periwinkle, is able to thrive in Ceylon upon the Cinchona tree, a plant belonging, botanically speaking, to a quite different family, and possessing very dissimilar chemical properties. Hence this species of insect is met with in Europe, Africa both North and South, Mauritius, Madagascar, India, and, we believe, in the Bermudas. We are, indeed, inclined to suspect that the hawk-moths tend to become cosmopolitan, with the exception of the frigid and sub-frigid zones and of desert territories.

It is rather curious, however, that the deaths'-head (*Acherontia atropos*) has not yet been recognised in India, though its near relatives, *A. styx*, *A. medusa*, and *A. morta* are here recorded. The first and the last of these three species were formerly regarded as varieties of *A. atropos.*

In so brief a catalogue, no information can, of course, be given beyond the synonymy, and the localities of each species, but it is nevertheless a valuable contribution to animal geography.

Tropical Africa. By H. Drummond, F.R.S.E., F.G.S. London: Hodder and Stoughton.

This volume is by no means entirely scientific in its subject matter. It is mainly, we may say, philanthropic, and, to some extent, even political. But the political chapter by no means displays the plague-spot of faction; and with the philanthropic portions, there are interwoven observations of very general interest.

The region specially explored by the author includes the valley of the Zambezi, from the coast to the junction of its great affluent, the Shire, the lakes Shirwa and Nyassa, and the hill country lying about the head of the latter in the direction of Lake Tanganyika.

To persons desirous of exploring East Central Africa, he recommends the route of the Zambezi in preference to land-routes from Zanzibar, a town which he designates as a "cesspool of wickedness." The black porters to be hired there are for "laziness, ugliness, stupidness, and wickedness not to be matched on any Continent of the world."

On his course up the Shire he noticed the exquisite blue and scarlet kingfisher, watching its prey from the boughs with a business-like air, almost comical. The adaptation of the adult crocodiles to the colours of their environment he regards as something wonderful. The agricultural capabilities of the river valleys he considers as unlimited. Indigo, orchella-weeds (now in much less request than heretofore), and calumba-root abound, and oil-seeds and sugar-cane could be produced in quantity. The elephant at home, Mr. Drummond tells us, is as nimble as a kitten. He thinks, at the same time, that "the sooner the last elephant falls the better for Africa." For every tusk an Arab trader purchases he must buy, borrow, or steal a slave to carry it to the coast. The extermination of the elephant will mark one stage at least in the closing up of the slave trade. The abundance and beauty of the zebras and the impudence of the lions in the country near the mission station of Blantyre are especially noticed. Throughout all Central Africa there is, it appears, a perfect net-work of foot-paths in all directions—narrow, certainly, and not too straight as far as minor turnings and windings are concerned, but distinctly marked-out and trodden hard.

Malarial fever he considers "the one sad certainty." It prevails over the whole east and west coasts, within the tropics, along the river courses, on the shores of the inland lakes, and in all low-lying and marshy districts. "Natives," the author tells us, "suffer from fever equally with Europeans, and this more particularly in changing from district to district, and from altitude to altitude." Quinine he pronounces the great remedy. He does not seem to have raised the questions whether the malarial

poison is introduced into the human system by the bites of mosquitoes, and whether homœpathic doses of certain snake-poisons act as a prophylactic?

To those enthusiasts who think that the opening out of the Shire and the Congo will cause an immense commerce to spring up, Mr. Drummond replies that it is difficult to create new wants among the Africans, and, secondly, that they have little to offer in exchange.

The chapter entitled "The Heart Disease of Africa, its Pathology and Cure," is illustrated by a map showing the tracts followed by the slave-hunters, the regions which they have entirely depopulated, and the districts where the inhabitants are kept in constant peril.

"The White Ant, a Theory," is the heading of a most interesting chapter. The author shows that in certain tropical climates the white ant—improperly so called—is probably a more important soil-maker than the earth-worm. His description of its operations in nest-building, foraging, and constructing covert ways is not in the least exaggerated, and we think that he makes out a very good case on the part of his neuropterous clients. We must not forget that Darwin nowhere regards the earth-worm as the sole soil-maker.

Not less interesting is the chapter on "Mimicry," of which Mr. Drummond finds many illustrations in the ways of African insects. He gives full confirmation of the observations of Wallace, Bates, and Belt, which he had previously considered as somewhat highly coloured. When he found that a wisp of hay, which had fallen upon his coat, was a living Phasma—when he saw a white splash upon a rock, which seemed simply a bird-dropping, begin to move, and found that it had a head, six legs, and a segmented body, he became convinced not merely of the reality of insect mimicry, but of its extreme closeness and accuracy. He avows that no mere verbal description, no comparison even of dead specimens, will convince the observer how hard such creatures are to detect in their native situations.

One peculiarity of tropical Africa does not seem to have attracted the author's notice — the comparative monotony of its fauna and flora. When once we are past the Sahara we find a multitude of the same forms recurring in Sierra Leone, in the islands of the central lakes and in Natal. What a contrast to South America and Oceania!

Here, however, we must pause. We should gladly follow Mr. Drummond in his wanderings on the Nyassa-Tanganyika table-land did space permit. But we may say in conclusion that "Tropical Africa" is at once a very readable and a very instructive book—attributes not always found in combination.

A Manual of Phonography. By Isaac Pitman. London Isaac Pitman and Sons.

We have received a new edition of this useful work, which is in several respects an improvement upon the original book—the examples being more numerous, and the matter generally of a sufficiently explanatory character for efficient self-instruction. It is not, however, easy to understand why certain popular forms of long standing should have been changed; and it may be safely asserted, at any rate as regards existing shorthand writers, that the alterations will prove to be a dead letter. For the sake of general convenience, it is obvious that a system so widely adopted and so long in use should not be modified, unless in view of a far greater necessity than appears to exist.

Abstracts of Papers, Lectures, etc.

GEOLOGICAL SOCIETY OF LONDON.

At the meeting on June 7, 1888, W. T. Blandford, LL.D., F.R.S., President, in the chair, the following communications were read:—

"On the Sudbury Copper Deposits (Canada)." By Mr. J. H. Collins, F.G.S.

These deposits occur in Huronian rocks. The author described two exposures, known as Copper Cliff and Stobie, about eight miles apart. At the former the ore was found in the face of a cliff of diorite about forty feet high.

The ore exists in three distinct forms:—

1. As local impregnations of siliceous and felspathic beds of clastic origin, in the form of patches and strings of cupreous pyrrhotite.

2. As contact-deposits of the same material lying between the impregnated beds and large masses of diorite.

3. As segregated veins of chalcopyrite and of nickeliferous pyrrhotite, filling fissures and shrinkage-cracks in the ore-masses of the second class.

The author considered the first as original, or of high antiquity; whilst the two latter are due to segregation produced either by intrusion of diorite, or by internal movements. He compared these deposits with those of Rio Tinto of Devonian age, showing their similarities and differences. At the latter place the intrusive masses are quartz-porphyries, and the metallic deposits consist mainly of bisulphide of iron. The ore-bodies in the Canadian deposits are not so large. From the cupreous pyrrhotite of Sudbury, rich though it be, compared with the Rio Tinto ore, the copper cannot be so chiefly extracted by the wet method, and the ore is of no avail as a source of sulphur. Nickel is everywhere present in the cupreous pyrrhotite of Sudbury, and of no advantage to the smelter. The differences above recorded are probably not due to differences in the containing rocks, since similar differences may be noticed in the pyritous deposits of Canada, where the country-rocks are identical.

"Notes on some of the Auriferous Tracts of Mysore Province, Southern India." By Mr. George Attwood, F.G.S.

The author was employed during parts of 1886-7 in inspecting a large area of mineral land in Southern India supposed to be auriferous, and the paper contained the results of his observations.

1. *Melkote Section.* This section (in the Hassan district of the province of Mysore), starting one mile west of Melkote in a north-easterly directon, exposed gneiss, mica-schist, hornblende-schist, quartzite, talc, and chlorite-schists, eclogite, and quartz veins, striking generally N. 20 degs. E., and having varying dips. The eclogite was described at length, and special attention was called to the flattening of the contained garnets, which were probably originally almandite; other evidences of great crushing were also noted.

In this section and on most of the schistose lands of Mysore a dull grey, nodular, and botryoidal calcareous deposit, known as "kunkue," is found in nullahs, on hill-sides, and on the detritus of old gold washings, and it was suggested that the contained lime was derived in great measure from hornblende-schists.

Many quartz outcrops, large at the surface but diminishing in thickness downwards, were met with at the east end of the section; these veins have a strike about N. 15 degs. E. to N. 20 degs. E., coincident with that of the schists.

Extensive gold-washings have been carried on in the ravines and hill sides, and the mode of occurrence and character of the gold were described.

The author considered the schists, as well as the quartz veins, to belong to very old series of rocks, probably Archæan.

2. *Seringapatam Section.* The second section was taken in a south-easterly direction from the 72nd milestone on the Seringapatam and Bangalore road to the N.W. side of the village of Arakere. Gneiss, hornblende, and mica-schists, etc., were here met with, striking about N. 20° E. with varying dips. These were traversed by auriferous quartz-veins which had been largely worked, and the author gave a description of the former methods of extracting the gold.

At the S.E. end of the section the schists were found to be much broken by porphyrite dykes of much more recent origin, most likely of Tertiary age. A small granite dyke intersected the Elliot lode diagonally, and was considered to be of Upper Tertiary age.

3. *General Observations.* The author described the results of traverses of other districts; he pointed out the evidences of great pressure which had broken up the gneissic rocks and compressed the schists, and conjectured that this might have been produced by the gradual rise of the Eastern and Western Ghats, and finally called attention to the great denudation which the Mysore plateau had undergone.

An Appendix by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S., gave an account of the microscopic characters of the schists, the flattened garnets, the porphyrites, etc., and in this it was pointed out that one set of rocks belonged to an ancient series, which, even if wholly or in part of igneous origin, assumed their present mineral structure and condition at an epoch remote from the present, whilst another set was certainly igneous and of more recent date.

4. "On the Durham Salt-district." By Mr. E. Wilson, F.G.S.

In this paper the author described the new salt-fields in the North of England, occupying the low-lying country bordering the estuary of the Tees, and situated partly in Yorkshire and partly in Durham.

The history of the rise and progress of the salt-industry in South Durham was given, since the first discovery of salt by Messrs. Bolckow Vaughan and Co. at Middlesbrough, in the year 1859.

The stratigraphical position of the saliferous rocks of the Durham salt-district was considered in some detail. The diverse views which have been previously expressed on this head were referred to, and reasons given for concluding that all the beds of rock-salt which have been hitherto proved in this field, and the red rocks with which they are associated, belong to the upper portion of the Trias, viz., to the Upper Keuper series (Waterstones subdivision).

The probable area of this salt-field, the limits of the distribution and varying depths of the chief bed of rock-salt were indicated, and the extent of its supplies pointed out.

In conclusion, the author called attention to the waste as well as to certain other disadvantages resulting from the process of winning the salt now in operation.

5. "On the Occurrence of *Calcisphæræ*, Williamson, in the Carboniferous Limestone of Gloucestershire." By Mr. E. Wethered, F.G.S.

The small hollow spheres, with varying forms of peripheral appendages, described by Prof. Williamson as *Calcisphæræ*, were found in the Carboniferous Limestone of Flintshire, and were suggested by him to be possibly Foraminifera or the reproductive capsules of some marine form of vegetation, although he admitted that no forms hitherto discovered afforded any definite support to this hypothesis. Prof. Judd expressed a belief that the objects were Radiolari; whilst Mr. Shrubsole discovered similar bodies in the Mountain Limestone near Llangollen, and conjectured that the described forms included both Foraminifera and Radiolaria.

The Author has discovered the *Calcisphæræ* in great numbers in the Carboniferous Limestone of Gloucestershire. He discussed the identity of certain calcareous rings ·005 in. in diameter, seen in sections of the limestone of Clifton, etc., with siliceous bodies which he had described in a recent paper read before the Society, and gave an account of the calcareous and siliceous forms which were both referable to *Calcisphæræ*. He commented upon the character of the carbonate of lime of the calcareous bodies, which presented a granular structure characteristic of the truly organic portion of the limestone, and not a clear crystalline aspect like that of the infilling or replacing calcite; he concluded therefore that the tests had been originally calcareous, and not siliceous replaced subsequently by carbonate of lime. This was urged as a strong argument against regarding the organisms as Radiolaria, and the author, whilst considering it unwise to come to a decided conclusion, believed it safe to say that they were Protozoa.

6. "Second Note on the Movement of Scree-material." By Mr. C. Davison, M.A. Communicated by Prof. T. G. Bonney, D.Sc., F.R.S.

After briefly recapitulating the substance of his previous paper, the author now communicated the results of experiments continued for a year. He gave a figure in which a continuous line represented, in millimetres, the movements of the upper stone from week to week, whilst a contiguous dotted line indicated the mean ranges of temperature. The rate of descent does not depend solely on the mean range. He gave the following comparison of rates of descent:—

	Average daily range of temperature.	Total mean descent in millim.	Rate of descent in inches per day.
Summer, 184 days ..	14°·4F.	8	·00171
Winter, 182 days ..	8°·0	5⅛	·00121

Thus the changes are not altogether proportional to the ranges of temperature, being relatively higher in the winter months. In considering the influence of rain, he observed that its effects are to slightly increase the rate of descent by diminishing the coefficient of friction, and by lowering the temperature, both as being itself generally colder than the air on the ground surface, and also owing to evaporation. He likewise observed that the rate of descent was nearly doubled during the latter part of the winter, chiefly owing to the effects of snow.

ROYAL HORTICULTURAL SOCIETY.

At the last meeting of the Scientific Committee Professor Scott reported on the abnormal flowers of *Gentiana acaulis*, which had five spongy outgrowths on the corolla, corresponding in position to the petals. The microscopic structure showed that they were due to excessive superficial growth of the external tissues, especially the epidermis. The outgrowths showed large irregular intercellular spaces. At many places they had coalesced so as to form closed cavities lined by epidermis. When vascular bundles were present, the positions of the xylem and phloëm were variable. The upper end of each outgrowth was flattened, and here the bundles, though generally concentric, showed an approximation of the xylem towards the upper surface. There was no evidence that these abnormalities were caused by insects; but if so, the regularity of the outgrowth shows that their attack must have taken place at an early age.

LIVERPOOL GEOLOGICAL ASSOCIATION.

The members visited Owens College, Manchester, recently, where they were met by Mr. Percy M. Kendall, who courteously conducted them through the museum and laboratories, pointing out the various objects of interest, and ably answered the very numerous questions which were propounded by a party of enthusiastic students. At the monthly meeting of the Association, held in the Free Library, William Brown Street, Mr. T. R. Connell in the chair, Mr. E. Dickson, of Birkdale, read an interesting paper on "The Goldfields of the Transvaal." After describing briefly the geological features of the African continent generally, he entered upon those of the Transvaal in detail, noting particularly that the quartz reefs are auriferous only when found crossing metamorphic rocks. After giving a lucid account of the gold reefs, he exhibited some specimens of the gold quartz in which no gold was visible to the unassisted vision, and described the various methods adopted to ascertain the presence in them or otherwise of gold. He also gave an interesting account of the various conditions in which gold is found, and the minerals with which it is associated. During the evening some specimens of Welsh gold ore were exhibited. Mr. J. Hornell exhibited several fossils which had been converted into pyrites, recently brought from Scarlet, Isle of Man. He also showed some specimens of radiolaria, in section, under the microscope. The Secretary, Mr. D. Clague, exhibited some mineral crystals from Laxey, some remarkable mosaic-like weathering of limestone, and some fossil polyzoa from Ronaldsway, Mammalian remains from Hango Hill, and a flint scraper of Neolithic age from Port-e-Chee, which he had collected during a recent visit to the Isle of Man.

Presence in Soil of the Bacillus of Typhoid Fever.—M. E. Macé (*Comptes Rendus*), in seeking to ascertain the cause of an epidemic of typhoid fever, made a special bacteriological examination of the soil round a suspected well. In addition to the bacillus of typhoid fever he met with *Bacillus colicommunis*, *B. violaceus*, *B. mycoides*, and a large *Diplococcus*.

Voracity of Trout.—A correspondent of the *Field* mentions that a trout weighing 3 lbs., recently caught in Aynhoe Park, was found to contain two young wild ducks and a small rat.

THE SOCIAL CONDITION OF THE BABYLONIANS.

Abstract of a Course of Lectures delivered by Mr. G. Bertin, M.R.A.S., at the British Museum. First Lecture—Private Documents.

Among the ancient documents recovered from Babylonia there is a class which has till lately attracted very little attention; these are small tablets of a private character. In them, however, is found a mine of precious information which enable us to see the Babylonians as they appeared in the daily intercourse of their life.

Primitively the Babylonians appear to have used for writing material papyrus, bark, or other vegetal substances, but, fortunately for us as all the documents of this kind have perished, they adopted at an early period small cakes of clay varying in size from a square inch to that of our note-paper These clay tablets were, in fact, their paper, and on them, with a wooden style, were written all their documents. They had the advantage of resisting the atmospheric influences of their damp climate much better than the Egyptian papyri or the Jewish leather rolls. At a certain period (about 2,000 B.C.) they even took the precaution of covering the tablet after it had been written on, with a coating of clay, and rewriting the document; these are what Assyriologists call case-tablets.

The private documents written on clay tablets, and of which there are in the British Museum numerous specimens, are of a very varied character, and all, or at least most, of them bear a date. The Babylonians did not, however, arrive at a regular system of dating until after many attempts. In the earliest documents various eras are followed, or an epoch-making event is given to designate the year. While the Ninevites adopted the eponimic system, the Babylonians devised in the same time one more perfect and more simple. They gave the year of the ruling king, but to avoid the confusion which would happen at the death of a king—for the last year of a king would be the first of his successor—they gave to the part of the year of the new reign completing the civil year the name of "year of accession." Besides the date given on the tablet, the age of a document may also be ascertained with a certain degree of accuracy by the style of the writing, the language, and its very wording, for each period adopted special formulæ.

Most of the private documents which have come down to us are contracts, or relate to loans repayable in instalments, When a loan was made a contract was drawn, stating the amount, the interest to be paid on it, the amount of each instalment, and the date on which it became due; every time a sum was paid back the borrower received a tablet stating the fact, and if he did not pay at the fixed time the lender had a tablet written as a protest in order to take legal measures. Sometimes securities were given, and the lender had the right to use the securities; if it were a house, he could inhabit it or let it till the full amount of the loan was paid back. Other contracts are leases, the description and measurement of the house or field are carefully given, with the names of the adjoining estates, the amount of the rent, its mode and time of payment being also stated.

The simple contracts of sales are very numerous and mention every possible article, from broken jugs, which were used as we know from other inscriptions for certain religious or magical ceremonies, to slaves, houses, and

fields. The payments were not always made in full at the time of the sale, but sometimes by instalments.

Among the trade documents may be also classed a certain number having the character of letters; they are letters of consignment: for instance, one merchant informs another that he has sent a certain quantity of grain, and asks for the amount to be placed to his credit; letters containing orders, in one case the buyer, after stating the amount of goods he wishes to obtain, names the party who will be present at the loading to see that this amount is correctly delivered. We have, lastly, real bills of exchange, or drafts to be paid at sight, either in silver or kind.

What may be called social documents are not so numerous, but are of greater interest. From the marriage contracts for instance, we learn what was the dowry brought by the bride; it consisted generally of a sum of money and properties such as slaves, house furniture, etc. Sometimes the marriage contract took the form of a deed of settlement, the bridegroom providing the dowry for his bride, giving her, as her own personal property, house, slaves, etc. We also possess several settlements made by the husband to his wife after they had been married several years; in this case it was no doubt done to provide for the wife in case of reverse of fortune, for in Babylonia, as in England since the Married Women's Property Act, creditors had no claim on the private property of their debtor's wife.

Cases of adoption were not rare. A man having no children or only daughters, often adopted a male child, not always in childhood but even in youth. To do so he had, like in our modern laws, to obtain the consent of his wife, for in the deed of adoption was generally included a deed of settlement. When the adopting party had a daughter, she as a rule became the wife of the adopted young man.

Before his death, a Babylonian was able to dispose of his property by will, and there were no restrictions. We possess several Babylonian wills in which the testator divided his estate among his children and other relatives.

There is a whole class of tablets referring to slaves. In one case a slave-child was given up by his mistress for three years in order that he might be taught the trade of a smith. In other cases slaves were given up with the special provision that the receiver should provide them with food and clothing till their last day.

All business in the Babylonian courts of law was transacted in writing; we have therefore a large number of judicial or legal documents, including powers of attorney enabling a man to act for another, and affidavits or sworn statements. If a man or a woman wished to make a claim before a magistrate or accuse any one, this had to be done in writing, signed by the scribe and witnesses. The defendant had also to answer in writing, and the decision of the magistrate was also written, and marked with his seal. The last resource of the defendant in a criminal case was the right of petition to the king, and we possess several documents in the form of letters, in which the condemned states the injustice of his sentence and appeal to the kindness of the king to redress it.

Private letters of a purely epistolary character have also been preserved. In one case a farmer informs his correspondent of the state of the crop, in another a man writes about a fugitive slave, in others commercial agents inform their employers of the progress of their operations. A great many letters were addressed to the king, and have therefore a semi-official character. They are not, however, all state-letters, in some cases they give the king information on private matters, such as the health of some private persons, the progress of some excavations, or of the building of some temples.

From this review of the various kinds of private documents it will be understood how important writing was considered in Babylon. Indeed, it was indispensable in every transaction and circumstance of life.

A knowledge of the Babylonian—or, as it is generally called, Assyrian or cuneiform—writing was not, however, of easy acquirement. Writing appears to have been brought from Egypt by the first colonists in Babylonia, and was at first, like the hieroglyphic, pictorial; the natural desire for quickness brought on abbreviations and conventional groups of lines, like the hieratic of Egypt. It is only when clay was used instead of papyrus, and a wooden style instead of a reed, that the characters assumed the cuneiform shape under which we know them. While the characters were simplified and abbreviated, nothing was ever attempted to improve the system of writing itself, the same complicated and cumbersome syllabary was used till the last period. Its great defect was principally the polyphonism, *i.e.*, the numerous values attributed to the same character, and the double use of the same signs sometimes as ideograms, sometimes as phonetics.

Phoneticism was more developed in the historical inscriptions than in the private and trade documents, in which ideograms were largely used to save space and time, and at the Greek period documents were written nearly exclusively in them. The syllabary was not only complicated but also contained a considerable number of signs (we know about six hundred), and if we add to this the various forms derived from special styles and periods of writing, we can quite understand that the Babylonian scribe must have spent a lifetime in acquiring a knowledge of this art, but he was well repaid for his trouble, as, owing to his attainments being indispensable, he was a real power in the state. As it generally happens, when writing is so difficult to acquire it was highly esteemed, and the Babylonian had great veneration for all written documents, to which doubtless we owe the preservation of the numbers of tablets which have come into our possession.

ASTRONOMICAL PHOTOGRAPHY.—The French journals signalize the interesting results obtained by the application of photography to the examination of the heavens. No fewer than 74 great negatives of different regions have been taken with the 0·33 metre object-glass at the Paris Observatory. Two special negatives have been taken for the forthcoming monograph of the Pleiades, and sixteen negatives with the object-glass of 0·11 metre, one of which shows 30,000 stars.

ACCURACY IN ACKNOWLEDGING AUTHORITIES.—Prof. Wiedemann (editor of *Wiedemann's Annalen*), in a circular forwarded to various journals and to eminent scientific men, complains of two abuses: firstly, in matter copied from one journal into another, the original source is often omitted; secondly, a paper read before a society is often sent simultaneously to several journals, which reproduce it as if it were an original article. This practice occasions much trouble and loss of time in seeking up the literature of any given subject.

THE CAUSATION OF VITAL MOVEMENT.

THE Croonian Lecture for 1888 was delivered on May 28, before the Royal Society by Dr. W. Kühne, Professor of Physiology in the University of Heidelberg, in the theatre of the Royal Institution, kindly lent by the managers, for greater convenience of illustration by lantern, by diagram, and by experiment. Professor Kühne has for thirty years carried on laborious and persevering researches into the terminations of nerves in muscles and the ultimate structure of muscles in many classes of animals, and much of his work is of the highest value. His lecture consequently excited great interest among physiologists, and although he preferred to deliver it in German, an English translation which was distributed among the audience was of essential service in grasping the difficult subject, "The Causation of Vital Movement." At the outset the Professor disclaimed the old idea that vital movement was a special animal function, whereas it is an attribute of all living matter. The unitary conception of life for which the age is distinguished rests in a higher degree on a knowledge of vital processes than is commonly recognised, and is just as much founded on physiological experience as on that of the forms of the organism. This is quite true of movement, the lecturer maintained. Movement is an attribute of protoplasm, both of animals and plants, and it is impossible to have a cell which does not preserve it at some time or other. This movement is a spontaneous activity which may go on in opposition to gravity, and which overcomes frictional resistance. Its cause can only be internal, and can only consist in chemical processes taking place within the protoplasm itself. But are these processes first set up by something coming from the outside, and determining the variability of the process? Physiological investigation has shown that protoplasm is irritable—that is, it reacts to stimuli, just like muscle; and electrical stimulation especially, the most indispensable instrument of physiology, first strengthens the movements, then brings the mass into a form with the least surface—*i.e.*, a sphere, in prolonged maximal contraction. We are compelled to regard all movement as either originating automatically or by direct external stimulus. The first idea of an observer, that something like will actuates even the lower protozoa, must be checked by our finding precisely the same phenomena in the colourless corpuscles of human blood, and the protoplasm of a plant-cell, and by contemplating the rhythmically contracting cells from the beating heart of a bird's egg after only a couple of days' incubation. Many causes of this motion are in recent times found to be non-essential; even oxygen can be dispensed with by many objects for lengthened periods. The lecturer detailed the delicate gradations between the most formless protoplasm, through flagella and cilia, and the primitive muscles of infusoria to the highest forms, showing that they possess a complete set of vital powers, excepting that of reproduction; while fully developed muscle is actually poorer by one power than elementary protoplasm, for it is wanting in automatism; thus protoplasm as opposed to muscle possesses elementary nervous properties. The muscle-cell is incomplete without the nerve-cell connected with it by the continuous nerve-fibre, which may be several feet long. Thus we have two separate cells united only for one purpose; one is the exciting nerve, the other the obedient muscle. Without concerning himself about the excitation of the nerve-cell, the lecturer devoted himself to considering whether the muscle-cell can be stimulated otherwise than through the nerve. The affirmative answer disposes of the animistic or neuristic view that the excitation and regulation of the various functions is everywhere the work of the nervous system. The ubiquity of nerve-branches has been disproved by exhaustive researches, in which Professor Kühne has borne a part. He showed experimentally that small pieces of fresh frog's muscle in which no nerve can be detected by osmium-gold staining, which displays the finest nerve-fibres, yet twitched at each effective stimulus. He also demonstrated the incorrectness of the assertion that everything that excited the nerve made the muscle twitch, and *vice versâ*. A further series of experiments showed that motor nerves can conduct centripetally, that the absence of nerves from a portion of muscle can be absolutely proved by a physiological test, and that it is not possible to excite the motor nerve of a muscle-fibre by any stimulus to the nerve ends within the fibre. Moreover, the excitement or contraction of a muscle does not travel back into its nerves. Professor Kühne has proved the vastly preponderant number of muscle-fibres is entirely free from nerves, and that the nerve endings are confined to very small tracts, termed fields of innervation. Consequently it is proved that muscle-fibre shares with nerves the property of propagating its own excitation, the velocity of conduction being from one-third to one-tenth of what it is for nerves. Thus the nerve only introduces a stimulus to the muscle, which propagates it by its own independent irritability in every movement and throughout life. All the stimuli, except the gaseous, which can act on muscle appear capable of being resolved into the setting up of electrical currents, and thus, said the lecturer, we find ourselves in the presence of the possibility of reducing all irritability to a reaction to electrical processes, and of seeing vital electricity elevated into immeasurable importance. Going on to discuss the precise endings of nerves in muscles as essential in considering how nerve acts on muscle, Professor Kühne showed diagrams from microscopical preparations which he had on exhibition, indicating in many animals the superficial nature of nerve endings in muscles, the hooked forms of their branches, turned as a rule towards each other, and the direct contact of the nerve end with either the transversely striped contents of the fibres or with the protoplasmic sarcoglia which traverses and penetrates it. The muscle-wave begins in the field of innervation, and has indeed been caught and fixed at the very beginning by sudden hardening of muscles. Professor Kühne then referred to the discoveries of Du Bois-Reymond in the following terms:—"The celebrated champion of electro-physiology has been able with the galvanometer to render the excitation of nerves, unattached to muscles or ganglion-cells, evident as the negative variation of the natural nerve current, to cause movement of a magnetic needle instead of a muscle, or to put the needle in the place of sensation." The currents of action of muscle have long been proved to excite nerves, and there are similar effects from nerve to nerve. Professor Kühne showed how he had succeeded in practically uniting two muscles, the nerves of which had been disposed of by poisoning with curare, so that the muscles acted as one. Stimulation and contraction were propagated from one end to the other. Any electrical insulation between the muscles stopped the current, consequently the first muscle must previously have excited

the second electrically. Here the lecture closed, without the learned Professor having claimed, as he might have done, that he had succeeded in proving to a large extent that muscle is ordinarily excited by actual electric currents, not merely by forces resembling them.—*Times.*

MESMERISM.

UNDER the names of mesmerism, animal magnetism, statuvolism, electro-biology, tellurism, hypnotism, etc., there exists a state or condition of the animal economy, obscurely known for ages, much talked about during the last century, and only beginning to be dealt with in a scientific manner. It is certain that hypnotism was known in Egypt and India in prehistoric times, and that it probably played a part in the wonders related concerning the ancient oracles. In the sixteenth century Paracelsus, and, after him, Helmont, became acquainted with certain mesmeric phenomena, and connected or confused them with the effects of terrestrial magnetism, of which at that time very little was known. Hence arose the name "animal magnetism." We must here remind our readers that the supposed influence of the human hand, or eye, or will, upon a magnetic needle, when carefully and conscientiously tested, is found to be purely imaginary.

The eighteenth century, with its curious intermingling of scepticism and credulity, took another step. Anthon Mesmer, of Mersburg, in Swabia, published in 1776 a thesis on the Influence of the Planets on the Human Body, whilst Father Hehl, a German Jesuit, effected, or believed that he had effected, the cure of several diseases by means of a loadstone and of magnetised steel plates. These two made a joint stock of their ideas, and formed a kind of partnership, which speedily came to an end. Mesmer was, neither in reality nor even in wish, a man of science. His object was notoriety and, above all, gain. With his vague, obscure theories we cannot attempt to entertain, or rather weary, our readers. Suffice it to say that he went to Paris, and quickly performed a number of wonderful cures, or seeming cures, and was fairly successful in both his aims. Among his followers the most conspicuous was the Marquis de Puységur, who connected the mesmeric phenomena with natural somnambulism. Societies called "Harmonies" were formed for the study of the new agency, chiefly among the upper classes of France, and afterwards of Germany and Russia.

In a few years, however, the French government appointed a commission of unprejudiced scientific men, including Lavoisier, Bailly, and Franklin, to investigate the whole matter. Their report was fatal to Mesmer's theories. They said: "This pretended agent is not magnetism, for, on examining the grand reservoir of the fluid by a needle or electrometer, neither magnetism nor electricity could be detected. We tried it upon ourselves and others without effect, and on blindfolding those who professed great susceptibility to its influence, all its ordinary effects were produced, when nothing was done but when they imagined they were magnetised, while none of the effects ensued when they were really magnetised but imagined nothing was being done. . . . The effects, therefore, are purely imaginary, and, although they have wrought some cures, they are not without danger, for the convulsions sometimes spread among the feeble in mind and body, and especially among women. And, finally, there are parts of the operation which may readily be turned to vicious purposes."

Mesmer, however, before the publication of this report, had realised a fortune and returned to his native town, careless of the further fate of his theories.

In the second quarter of the present century a new departure was taken by Kieser, a German physician. He grouped the phenomena of mesmerism, somnambulism, catalepsy, etc., under the name of Tellurism, and in an erudite work, in two volumes, he argued that they were due to a peculiar "force," or, as we should now say, form of energy, radiated out of the earth in antagonism to the sun, and of the moon in antagonism to the earth. He constructed large troughs filled with scrap iron, iron ore and water, into which he plunged iron rods, from which the telluric virtue was to be conducted to the patients or subjects by means of chains. A multitude of natural phenomena were traced to this agency. But the theory lacked demonstration, and went down with the decline of the school of physico-philosophers (Naturphilosophen).

In 1841 James Braid, a Manchester surgeon, laid the foundation of a scientific treatment of the subject. He had witnessed certain experiments performed by one Lafontaine, a French lecturer on mesmerism and suspected fraud or illusion. He set to work to unmask the supposed imposture, but soon became convinced of the reality of the facts produced, but hitherto misinterpreted. After some time spent in experiments, he published his work "Neurhypnology." Here, however, he was somewhat led astray by his leaning to phrenology. It is remarkable that the English mesmerists generally found in their experiments confirmation of the truth of the system of Gall and Spurzheim, whilst the German mesmerists, who did not accept that system, found no such indications.

But the work which Braid had begun was taken in hand by Professor Charcot, of the Salpetrière, a specialist in the diseases of the nervous system. In undertaking the study of hypnotism, he set out from hysteria as the simplest and broadest basis. He proved that only some individuals are capable of being hypnotised, or, as it was formerly called, mesmerised. The idea of the operator communicating to the subject some peculiar fluid or imponderable had been refuted by the Abbé Faria in the beginning of the century. Susceptible persons after gazing long at some bright object fall easily into the hypnotic state. It is remarked that persons who in childhood have been liable to sleep-walking, are apt to become subsequently good subjects for hypnotism. It is found that the surface of the body, in susceptible persons, present certain points named hypnogenic zones. If these are pressed, hypnotism is the result.

Meantime certain quacks laid hold of Braid's method of operation, and gave it the name of "electrobiology."

(To be continued.)

THE LATE WINTER.—*Ciel et Terre* remarks that the winter of 1887-88 does not occupy the first rank, either in the frequency or the intensity of frosts. But it surpasses all in the number of snowy days and in the depth of snow-fall. Further, all its seven months, from October to April inclusive, have shown a mean temperature below the average. It may hence claim the second rank among the bad seasons of the century, that of 1844-45 holding the first place.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

A CIRCLE PROBLEM.

Permit me to make a few remarks on a letter appearing in your last issue, and entitled "A Circle Problem." The problem which your correspondent proposes is: "How much farther does the outer handle of one of the carriages of an 'inner circle' train travel in one journey than the inner handle, the circumference of the circle being 13½ miles, and the handles being 9 ft. apart?" He goes on to say "Reduce the circumference to feet, =63,360, divide by 3·14159 to find the diameter, =20,168·1 ft. Take *this* as the distance travelled by the inner handle." Now, 63,360 is the number of feet in 12 miles, not in 13½ miles, which=71,280 ft.; and the word *this*, evidently, from the context, means 20,168·1 ft., which is the diameter of the circle, and, therefore, cannot possibly be "the distance travelled by the inner handle." Again, your correspondent says: "A little reflection shows that the circumference of the circles has nothing to do with the problem, UNLESS *they are several thousand miles in diameter.* The difference *will always be* the circumference of a circle 18 ft. in diameter." The latter sentence contradicts the former, and in the last paragraph of his letter your correspondent proves that the circumference of the circles has nothing to do with the problem, ALTHOUGH the circles are several thousand miles in diameter. How much more interesting to many readers of SCIENTIFIC NEWS would the problem have been had "A. P. T." shown why the difference in the distance travelled by the inner and outer handles of the carriage is always the same, no matter how great may be the circle they perform. Perhaps he will do this in a subsequent issue of your valuable paper. If not, with your permission, I will make an attempt to explain it.

There is one more error in "A. P. T.'s" letter that I would like to mention. In the last paragraph he says, "If the track encircles the earth *the diameter would be about* 25,000 *miles in diameter.*" Who is responsible for this statement?—whether writer, pen, or printer I cannot say, and I leave it to my fellow-readers to make what they can of it.

Apologising for encroaching on your valuable space,

KUKLOS.

THE QUANTITY OF LIFE.

Permit me to point out an important difference between life and all the various modifications of energy met with in non-vitalised matter. We can measure gravitation, heat, light, electricity, magnetism, and chemical force we can discuss them quantitatively and can examine their numerical relations; but can we do the same with life? Can we say that there is more life in an adult man than in a young child, in a healthy man than an invalid, in an elephant than in a mouse, in a vertebrate animal than in an insect or a mollusk, in an animal than in a tree? Are we even prepared to say whether the idea of quantity is applicable to life at all?

J. W. S.

TECHNICAL EDUCATION.—Dr. Gladstone, F.R.S., in giving evidence before a special committee of the London School Board, submitted the following statement:—"Professor Sylvanus Thompson told me that the only elementary school in London from which the Finsbury College could draw youths qualified for the technical classes was that of St. Thomas Charterhouse, where a good deal of scientific instruction is given and the boys are encouraged to make their own apparatus." Mr. Edward Bond, Assistant Charity Commissioner, instanced only three primary schools in England, viz., the higher primary schools of Manchester and Sheffield and St. Thomas Charterhouse, London, as giving an education calculated to develop intelligent artisans. Considering what is spent on education in this country, better results ought fairly to be expected.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

EXTINGUISHING OIL LAMPS.—An extinguisher for oil lamps has been patented by Mr. F. R. Baker, of Birmingham. The extinguisher consists of a strip of metal, which is fastened to the bottom of the wick tube through which it passes, and is bent over to form a cap. The piece is normally held back, but upon lowering the wick the cap springs over it and extinguishes the flame.

CAR-COUPLING.—A car-coupling has been patented by M. G. E. Ribault, which consists in attaching to each car a sleeve with a bell mouth, and opposite to it on the other car is a looped bar, which enters the sleeve, and it is then fastened by a catch which drops automatically. When it is desired to uncouple the cars the catches are raised and are held in position by a spring, and the act is accomplished.

LAMP TRIMMER.—An improved lamp-trimmer has been patented by Mr. E. Baller, and consists in constructing it so that the parts cut off the wick are prevented from falling into the burner or lamp when the same is being trimmed. A box is placed on the trimmer, and the parts cut off are forced into it by means of a guard. The box being kept closed by spring studs on the arms or handles of the trimmer when not in use.

LIGHTING MATCHES.—A device for lighting matches has been patented by Mr. T. E. Ware, of Bristol. It consists of a tube having a tapering end partially closed by serrated springs, and provided with a longitudinal slit for the insertion of a match. The match, which is laid with its head towards the end, is ignited by being partially ejected by a plunger, and is then held by the springs while used for lighting purposes.

INCANDESCENT GAS LAMP.—An incandescent gas lamp has been patented by Mr. H. Schlichter, of 95, Milton Street, London. According to this invention, gas and air are conducted by separate pipes to the chamber, the mixture issuing by the burner. The issuing gas is ignited by impinging upon spongy platinum, and heats a platinum wire or strip. The flame may then be extinguished; the mixed gas and air impinging upon the platinum wire causes it to remain incandescent and emit light.

WINDOW FASTENER.—An improved fastener for windows has been patented by Messrs. G. and S. D. Duffy, and consists of a brass screw which is attached to the lower sash, and a socket attached to the upper one. Inside the brass screw is a hardened steel pin, which is loose, and thus, should the outer screw of brass be cut, the said steel pin would revolve, being loose, inside the outer screw, and consequently could not be cut through. The fastener also permits of the sashes being screwed tightly together, and consequently prevents them rattling.

SPEED OF VESSELS.—An apparatus for indicating the speed of a vessel and the distance run has been patented by Mr. C. Sperry, and consists of an instrument operated by the varying pressures in tubes projecting from the bottom of the vessel, produced by the resistance of the

water when the vessel is in motion. An indicator is attached which shows the speed at which the vessel has run. In combination with this is a chronometer and counting device, so that the hours are indicated on one dial and the counting device registers the number of knots run in the time.

ELECTRIC BELL INDICATOR.—An improved electric bell indicator has been patented by Messrs. J. and E. Eshelby, which consists in making the indicator automatic, so that if the attendant omits to set up the previous indicator, the next bell ringing affects that, and thus there is never more than one disc exposed, which avoids confusion. To meet the case of two stations ringing in quick succession, a temporary indication of the last disc raised, is given by causing it to vibrate a minute, and finally there is an arrangement whereby the attendant can clear the board for a time if leaving the room.

TIME INDICATOR.— A new mode of indicating time has been patented by Mr. A. J. Ready, and consists in utilising the principle of capillary attraction of fluid bodies to obtain a measure of time. A strand of cotton or other material, weighted, if necessary, to retain it in a vertical position, is connected at top to some porous material, as calico or blotting material, on which is provided a scale which is marked off according to the speed at which various liquids will travel through the porous material. The strand is inserted or hangs in a vessel containing some fluid, which rises and so indicates the time on the scale.

ELECTROLYTICALLY TREATING SEWAGE.—A method of electrolytically treating sewage, water and other liquids, has been patented by Mr. W. Webster, jun., of Lee, Kent. The invention consists in purifying sewage and other impure liquids by electrolytic action, by causing the liquid to flow through comparatively narrow channels in which it is brought in contact on the one hand with negative electrodes of iron having very extended surfaces, and on the other hand with extended positive electrodes of either iron, carbon, or other suitable material, so that the liquid is subjected to the action of nascent ammonia evolved at the negative electrodes, and nascent oxygen, and chlorine evolved at the positive electrodes, producing both the precipitation of solid matter and the oxidation and purification of organic matter contained therein. In purifying water, the filtering medium through which the water is passed, either itself constitutes the positive electrode or has a positive electrode imbedded in it, while the negative electrode is either also imbedded in a filtering medium or is otherwise in electrical contact with the water to be filtered.

ILLUMINATED FOUNTAINS.—An apparatus for illuminated fountains has been patented by Messrs. Galloway and Beckwith, of Knott Mill, Manchester. The valves which admit the water from the main to the different sets of jets are opened and shut by a set of levers which are placed in a commanding position. Chains or cords passing over guide pulleys connecting the levers to the valves. The fountain jets are illuminated by electric or other lights placed underneath coloured glass slides, which are connected in groups and actuated by another set of levers, actuated by a hydraulic or pneumatic motor or by hand. Several successive colours may be on the glass screens, which, by their movement, are brought over the lights.

ANNOUNCEMENTS.

THE FRENCH ACADEMY OF SCIENCE.—M. Masters has been elected a corresponding member for the Botanical Section in place of the late Professor Asa Gray.

MIDDLESEX NATURAL HISTORY AND SCIENCE SOCIETY.—The second annual soirée of the Society was held on June 7th. Amongst the exhibits were Robertson's writing telegraph and an egg of the great auk.

JUNIOR ENGINEERING SOCIETY.—The adjudication of the prize offered for the best paper read by the members of this Society during the seventh session has resulted in its being awarded to Mr. Francis R. Taylor for his paper on "The Illumination of Lighthouses." The prize will be presented by Professor W. Cawthorne Unwin, M. Inst. C.E., President-Elect, at the inaugural meeting of the eighth session in October next, at which the Presidential address will be delivered.

PHOTOGRAPHIC CONVENTION OF THE UNITED KINGDOM.—The Birmingham meeting will take place in the Masonic Hall, the head-quarters of the gathering, on the 23rd of July, when the evening exhibition, which forms an important part of the programme, will be opened. There will be an inaugural address by the Mayor of Birmingham, and a conversazione, besides the reading of papers, lantern displays, a dinner, and a smoking concert. An entire week will be devoted to the proceedings, which will include an organised series of excursions to interesting places in the environs and adjoining counties, visits to manufactories, and so forth.

SOCIETY OF CHEMICAL INDUSTRY.—The annual general meeting will be held in Glasgow, on Wednesday, Thursday, and Friday, the 4th, 5th, and 6th of July next, instead of the 18th, 19th, and 20th, as previously announced. The annual meeting will take place in the Bute Hall, of the Glasgow University, on Wednesday, 4th, at 11 a.m. The annual dinner will take place at the Grand Hotel in the evening. For Thursday, the 5th, arrangements, have been made which will enable the members to visit some of the following works: Forth Bridge Works, Broxburn Oil Works, Thornliebank Print Works, Langloan Iron Works, Summerlee Iron Works, Nobel's Explosives Co.'s Works, Singer Sewing Machine Co.'s Works, Messrs. J. and G. Thomson's Shipbuilding Yard, and the Glasgow Cleansing Department. On Friday, the 16th, after inspecting Messrs. J. Walker and Co.'s Sugar Refinery, the members will be taken for an excursion on the Firth of Clyde.

LUSTRELESS SURFACE ON STEEL.—A finely-polished lustreless surface on tempered steel can be procured by either of the following operations. After the steel article has been tempered, it should be rubbed on a smooth iron surface with some pulverised oilstone until it is perfectly smooth and even, then laid upon a sheet of white paper, and rubbed back and forth until it acquires a fine dead polish. Any screw-holes or depressions in the steel must be cleaned and polished beforehand with a piece of wood and oilstone. This delicate, lustreless surface is quite sensitive, and should be rinsed with pure soft water only. A more durable polish is obtained by first smoothing the steel surface with an iron-polisher and some powdered oilstone, carefully washing and rinsing. Then mix in a small vessel some fresh oil and powdered oilstone; dip into the end of this mixture the end of a piece of elder pith, and polish the steel surface with a gentle pressure, cutting off the end of the pith as it commences to become soiled. In conclusion, it should be thoroughly cleansed in soft water, when the article will be found to have a fine white, lustreless polish.—*Iron.*

SILVER-PLATING SOLUTION.—Dissolve in a pint of distilled water 50 grs. of silver nitrate and 8½ ozs. avor. of potassium iodide. Employ a current of moderate strength. When a sufficiently thick deposit has been obtained, wash the object with a solution of potassium iodide in water (1·4), then with pure water, and burnish.

DIARY FOR NEXT WEEK.

Monday, June 25.—

Tuesday, June 26.—

Wednesday, June 27.—College of State Medicine, at 4 p.m.—*The Rise and Progress of Sanitary Engineering within the Present Century;* by Sir Robert Rawlinson.

Thursday, June 28.—Camera Club, at 8.30 p.m. — *Informal Meeting.*

Friday, June 29.—British Museum, at 3.30 p.m.—*The Social Condition of the Babylonians;* by Mr. G. Bertin.

Royal United Service Institution, at 3 p.m.—*The Defence of our Mail Routes in War;* by Captain J. C. R. Colomb.

Saturday, June 30.—Geological Association. — *Excursion to Rickmansworth.*

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

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To Emigrants.—Beautiful double Breech-Loader, splendid condition, 3 guineas, approval.—HILLSDON, Harbour House, Folkestone.

Dead Black Varnish for Cameras, Lenses, Dark Slides, etc. —Bottles, post free, 1s. 3d.—H. SOUTHGATE, Maidenhead.

Photography. "Vade Mecum."—A serviceable, complete set for 32s. 6d. Everything necessary for taking, printing, finishing. Photo and particulars free.—MERCER, King Street, Sparkbrook, Birmingham.

Microscope Slides. Large stock, interesting objects, from 5s. dozen; lists; approval.—MICROSCOPIST, 334, Caledonian Road, London.

British Flowering Plants, Weekly supplies required for practical study.—Address, stating terms, B., 22, Osborne Terrace, Clapham Road, S.W.

Do your own Electro Plating and Gilding. System inexpensive. Particulars one stamp.—PERKS, 47, Alexandra Road, Richmond, Surrey.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

Sound, Light, and Heat. By the late Thomas Dunman. Revised and Completed by Chapman Jones, F.I.C., F.C.S., Member of the Physical Society of London, etc. With Explanatory Diagrams. London: Ward, Lock, and Co. Price 1s.

Norfolk Broads and Rivers; or, The Waterways, Lagoons, and Decoys of East Anglia. By G. Christopher Davies, Author of "The Swan and Her Crew." New and cheaper edition, illustrated with seven full-page plates. London: W. Blackwood and Sons. Price 6s.

Mining and Quarrying (A First Book of). With the Sciences connected therewith. For Use in Primary Schools, and Self-Instruction. By J. H. Collins, F.G.S., Mining Engineer, etc. Second Edition, revised. London: Crosby, Lockwood and Co. Price 1s. 6d.

An Atlas of Anatomy; or, Pictures of the Human Body. In 24 large Coloured Plates, comprising 100 separate figures, with descriptive letterpress. By Mrs. Fenwick Miller. Third edition. London: E. Stanford. Price 12s. 6d.

Annals of Botany, Nos. III. and IV. Edited by I. Bayley Balfour, M.A., M.D., F.R.S.; S. H. Vines, D Sc., F.R.S.; and W. G. Farlow, M.D., Harvard, U.S.A. Containing Articles by W. M. Woodworth, T. Johnson, J. R. Green, F. W. Oliver, Anna Bateson, F. O. Bower, D. H. Scott, W. C. Williamson. London: Clarendon Press Warehouse. Price 18s.

Choice British Ferns, their Varieties and Culture. By C. T. Druery. Illustrated. London: L. U. Gill. Price 2s. 6d.

Lessons in Elementary Mechanics, by W. H. Grieve. London: Longmans, Green, and Co. Price 1s. 6d.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, June 11th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	45·4 degs., being 1·9 degs. below average.	5·7 ins., being 0·8 ins. above average.	403 hrs., being 14 hrs. below average.
England, N.E.	46·6 ,, ,, 2·2 ,, ,, ,,	3·8 ,, ,, 0·7 ,, below ,,	338 ,, ,, 56 ,, ,, ,,
England, East	48·3 ,, ,, 2·6 ,, ,, ,,	2·6 ,, ,, 1·6 ,, ,, ,,	393 ,, ,, 66 ,, ,, ,,
Midlands ...	48·4 ,, ,, 2·3 ,, ,, ,,	3·7 ,, ,, 0·8 ,, ,, ,,	348 ,, ,, 50 ,, ,, ,,
England, South	48·9 ,, ,, 2·6 ,, ,, ,,	3·6 ,, ,, 0·7 ,, ,, ,,	383 ,, ,, 35 ,, ,, ,,
Scotland, West	46·8 ,, ,, 1·7 ,, ,, ,,	9·5 ,, ,, 3·1 ,, above ,,	360 ,, ,, 59 ,, ,, ,,
England, N.W.	47·7 ,, ,, 2·8 ,, ,, ,,	3·6 ,, ,, 1·0 ,, below ,,	328 ,, ,, 100 ,, ,, ,,
Scotland, S.W.	48·7 ,, ,, 2·4 ,, ,, ,,	4·9 ,, ,, 1·1 ,, ,, ,,	401 ,, ,, 55 ,, ,, ,,
Ireland, North	47·7 ,, ,, 2·3 ,, ,, ,,	6·7 ,, ,, 1·5 ,, above ,,	321 ,, ,, 87 ,, ,, ,,
Ireland, South	49·6 ,, ,, 1·4 ,, ,, ,,	8·1 ,, ,, 2·2 ,, ,, ,,	359 ,, ,, 84 ,, ,, ,,
The Kingdom...	47·8 ,, ,, 2·2 ,, ,, ,,	5·2 ,, ,, 1·7 ,, ,, ,,	363 ,, ,, 60 ,, ,, ,,

Scientific News

FOR GENERAL READERS.

VOL. I.—No. 26. (*New Series.*) FRIDAY, JUNE 29th, 1888. [Weekly, Price 3d. By Post, 3½d.

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SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

THE pictures of hailstones on pages 557 and 581 are very interesting in connection with a theory put forward eight or nine years ago by Schwedoff, a Russian philosopher. He supposes that hailstones have an extra-terrestrial origin, come to the earth from outside space, as meteorites are known to come.

This is a bold original theory, and has therefore been flippantly pooh-poohed by scholastic scientists. Those, however, who are addicted to thinking independently will regard it very differently. I have carefully considered the subject, and without venturing to affirm that all hailstones are of cosmical origin—that is, without denying that some may be formed within our own atmosphere, I have little or no doubt that some are picked up from without by the earth in the course of its journey in space.

My chief reasons for believing this are the following. It is a well-proved and established law that aqueous vapour diffuses itself into a vacuum or a gaseous plenum with a tension or elastic energy, proportionate to the temperature to which it is raised. Also that the solar rays are largely absorbed by aqueous vapour, and its temperature is raised thereby.

What, then, must happen when the sun shines on the far-away extensions of our atmosphere, and on those of the atmospheres of other planets, and on those of the sun itself, all of which contain aqueous vapour?

Obviously such vapour must diffuse itself into space farther and farther away so long as the solar rays maintain it in a gaseous condition. Therefore, if there were no compensation, a continual evaporation of the surface waters into the atmosphere, and a diffusion of this vapour further and further into space must occur, until in the course of a geologically short period our world would be dry and arid as the moon. In like manner the material of the polar snows and the seas of Mars would speedily leave him; so would the water of the vaporous jacket of Venus, and of the deep envelope of Jupiter.

But let us follow this outspreading vapour a little further, limiting at first our attention to that which has departed from the earth. What would happen to some of it which, in the course of its outspreading, should come within the night-shadow of the earth? To answer this, remember that radiation and absorption are correlative; good absorbers are correspondingly good radiators. Such being the case, the vapour must rapidly give out its heat when shaded from the sun and surrounded by the temperature of space. The result of this must be condensation, not merely to the liquid, but to the solid state, into minute feathery crystals of hoar frost. Inter-gravitation and other forces which I have not space to describe in detail would operate to effect a greater or less degree of aggregation of these solid particles, and thus to form the snow-like material which constitutes the inner portion of hailstones having any considerable magnitude.

The structure displayed in the engravings on pages 557 and 581 is easily explained by this hypothesis. The spherical nucleus is in complete harmony with the theoretical structure of the original hailstone which, entering the denser regions of our atmosphere, would at first be externally heated by friction, and thus an outer film would be melted and volatilized. But this same friction would speedily check its speed, far more speedily than the outer heat could travel to any considerable depth through the very bad-conducting ice. The velocity being thus checked, another action would follow in the course of its slower downward course through humid atmosphere. The space-cooled mass would condense and crystallize the atmospheric vapour around it, and this condensation would become considerable in cases of violent tempest, where the hailstones are whirled about by the wind, and thus suspended for a considerable time before reaching the earth.

That hailstones may have an excessively low temperature has been proved by actual experiment. As an example, I refer to the *Annales de Chimie et Physique*, series 6, vol. 3, page 425 (1885), where Boussingault records his observations on hailstones that fell in the

department of the Loire, where the temperature of the air was 79° Fahr. That of the hailstones was 18½° below the freezing point.

We have many records of coloured hailstones. (See *Nature*, May 21st and September 10th, 1885, *Philosophical Transactions*, No. 203, etc., for examples.) Their colours were red, brown, and grey, and the colouring matter appears to have been oxide of iron, but reliable analyses are wanting. The flaming hydrogen projected in the solar prominences must terminate in aqueous vapour mixed with metallic vapours, chiefly iron; but what finally becomes of such mixture must depend on the velocity of ejection. The measured velocity of some prominences proves to be sufficient to eject its material beyond the distance of the earth's orbit. Such vapour, while directly exposed to solar radiance, would probably remain in gaseous condition, but if the earth's shadow should sweep into any of it, condensation into solid particles must immediately take place, and such particles would fall upon the earth, carrying with them any other materials with which they might be associated.

Another theory has been more recently put forward by M. Andries, who ascribes the formation of hailstones to ascending whirlwinds. We know that such ascending whirlwinds do exist by the fact that dust is sometimes carried upwards in considerable quantities, but we do not yet know the upper limit of such ascending action. Assuming it to be considerable—say three or four miles—and that warm air saturated with aqueous vapour is carried to such a height, its sudden expansion must be attended with sudden cooling, and under certain conditions—as at night, for example—the cooling would effect condensation into ice particles, hoar frost or snow, which by the whirling might be aggregated into hailstones.

This action is similar to that which I have described above, but of a more exceptional and limited nature.

In working out the rationale of this subject we must not fail to give proper weight to a fact which is too often overlooked, and which at first glance may appear parodoxical, viz., that as we ascend to rarer and colder regions of the upper air the intensity of the heating power of the solar rays increases. But these rays cannot do the work of heating unless there is something to be heated. In passing through empty space or diathermanous matter they do nothing but go on.

In the course of an ascent of Mont Blanc I made an instructive experiment to illustrate this. During the first day's climb the skirts of my coat were wetted by falls on the sloppy glacier. At night on the *Grands Mulets* they were frozen, and when I came into sunshine on the *Grand Plateau* the sunward side speedily thawed. This suggested the experiment of turning round like a joint roasting before a fire. On doing this very slowly I was alternately frozen and thawed on all sides, as they fell in shadow or sunshine, and the ice on my coat tails was in the form of sparkling crystals.

Some of my readers will doubtless find objections to Schwedoff's theory. I know beforehand what these objections are likely to be, and will discuss them in my next, especially the "manifest absurdity" of Sir William Thomson.

Anæsthetics in China.—It appears that in China prison officials sell to the persons in their charge pieces of an anæsthetic soap, to be chewed before or during the torments applied both to the suspected and to the convicted.

THE NEW RINGS OF SATURN, OUTSIDE OF THOSE PREVIOUSLY KNOWN.

It is known that besides the two principal rings, always visible, Saturn possesses a third which remained for a long time unperceived by reason of the feeble lustre of its nebulous matter, and which is not visible even with the sixteen centimetre refractor of the Observatory at Grignon.

Beyond these known rings, the attention of Dom Lamey has been frequently and spontaneously drawn for about twenty years to certain ring-shaped lights visible between the regions in which revolve Mimas and Titan, the first and the sixth satellites of the Saturnian system. These rings, which are lost in the zone of illumination surrounding Saturn, are but very rarely seen in their entirety. According to a communication recently made by Dom Lamey to the French Academy of Sciences, these rings are generally more luminous on one side, which varies in position; the chief lustre generally coincides with the nearest satellite, but often surpasses it in intensity.

The first observation of these rings dates back to August 2nd, 1868, when he recognised them at Strasburg with a small equatorial of ten cm. aperture. Subsequently he tried to re-discover them at Dijon, with the same instrument, but unsuccessfully. It was only on February 12th, 1884, when installed on the summit of Grignon, in the midst of a very clear atmosphere, and furnished with a more powerful instrument, that he was able again to distinguish these lights, which then presented themselves in the form of perfectly definite rings. Up to the date of his memoir (June 5th, 1888) he is only able to produce nineteen sketches of these rings, because he had remained for a long time undecided as to the nature of the phenomena observed. But he has since been convinced that they cannot be produced by anything in our atmosphere nor by the instrument employed, the images having never changed their form or relative position on examination with objectives of different apertures and focal lengths, fitted with eye-pieces sometimes positive and sometimes negative, and giving various magnifying powers up to 250 at least. Nor can these rings be due to any illusion produced by the eye or the imagination, since two of his colleagues, Dom Et. Siffert, and Dom Fl. Démoulin have also seen and sketched them, agreeing with him as to their form and the position of the maximum of lustre, and that in a quite spontaneous manner.

These rings are four in number, if we count as such the luminous zone bordering the exterior of the outer ring. This zone has been observed only on the side which is turned towards our planet. It is generally nebulous, but it frequently becomes resolvable into a crowd of small luminous points, scattered along an elliptical arc. Beyond this zone there exists an elliptical interval, the darkness of which is sometimes extremely marked. Then begins a vague nebulosity, of a milky appearance, which gradually becomes more distinct, becoming intensified up to the vicinity of Enceladus, which limits, so to speak, this second nebulous ring. After the fourth, this is the faintest, the third being the brightest and the most frequently visible.

This third ring does not seem to pass beyond the orbit of Tethys; this satellite seems to graze the outer margin of the ring, and to round off its outline.

Lastly, between Dione and Rhea, Dom Lamey has observed the outer margin of a fourth ring, very faint

and diffuse at its edges, which can be seen only with small magnifying powers.

The study of these rings seems to promise certain interesting revelations in celestial mechanics, *e.g.*, the explanation for the anomaly found by M. Baillaud for the mean movement of Tethys, the satellite which revolves on the exterior margin of the densest ring. Another point is the detection of the actual slow transformation of a nebulous ring into a satellite.

JORDAN'S PHOTOGRAPHIC SUNSHINE RECORDER.

AT a meeting of the Royal Meteorological Society a paper was read by Mr. Jordan on an improved form of this instrument, by means of which the record is obtained in a straight line at right angles to the hour lines printed on the chart, instead of in two curved lines

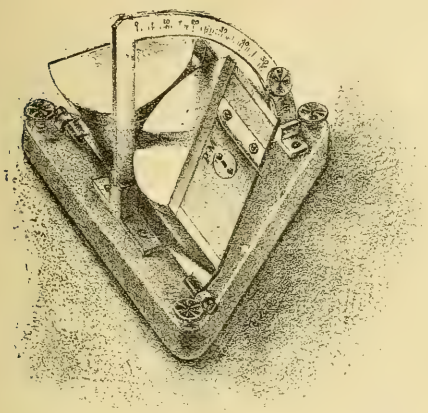


FIG. 1.

varying in the amount of their curvature with the seasons of the year, as was the case with the original instrument. The new form of instrument consists of two semi-cylindrical boxes, or dark chambers, into which the sensitised charts are inserted. These are attached to a flat triangular plate at an angle of 60 degs. to each other, and are capable of adjustment to any angle, according to the latitude of the station. When the instrument is placed in proper position facing due south, one of the cylinders faces the south-eastern horizon and the other the south-west, the former receiving the direct solar rays from sunrise to noon, the other those from noon to sunset, in each case the rays entering the chambers through a narrow aperture situated in the centre of the circle, on the inner surface of which is placed the sensitised chart. The whole is attached to a triangular stand, fitted with levelling screws.

The construction of the instrument will be more clearly understood by reference to the illustrations. Fig. 1 is a general view of the instrument adjusted at an angle for taking observations in a latitude 51 degs. Fig. 2 is a plan showing the semi-cylindrical chambers AA, the dotted lines indicating the direction of the solar rays as they enter the apertures BB at the different hours of the day. ELF is the triangular plate on which the cylinders are fitted, and which is pivoted on the centres GG. JK is the divided arc. The projecting screens CC are for the purpose of determining accurately the conclusion of the morning and the commencement of the afternoon record, and are so adjusted that the shadows projected from these edges shall fall vertically on the apertures at noon. At the moment of noon both charts receive the rays of sunshine, but immediately before and after they fall on one

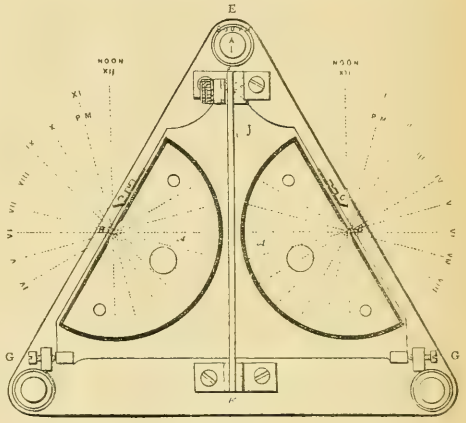


FIG. 2.

of them only, so that no more sunlight than is necessary for obtaining the record is allowed to enter the dark chambers.

Some of the advantages gained by this form of the instrument over the previous one will be apparent: 1. The trace of sunshine is always recorded in a straight line. The measurement of it is thereby rendered more simple and accurate. 2. The apertures for the admission of the rays are so placed that each presents a full front to the horizon, thereby giving greater advantage for the recording of early and late sunshine. 3. The fact of the morning and afternoon charts being in separate chambers and independent of each other offers great facilities for changing the charts at convenient times of the day; and although the charts are in two parts, they admit of being joined together as shown in fig. 3, so as to form one con-

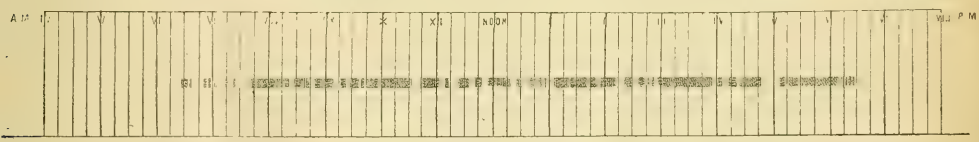


FIG. 3. COPY OF A CHART.

tinuous chart for each day. These and other improvements help to give this form of recorder an advantage over the one hitherto in use. It is, however, a rather more expensive instrument.

The photographic process used for sensitising the charts is that known as the cyanotype, discovered by Sir John Herschell in the early days of photography, but slightly modified, in order to prevent the washing away of the fainter tints of the trace in the process of fixing, which is done simply by washing the charts for a few minutes in cold water. It may be mentioned that the charts are supplied ready prepared by the makers of the instruments, Messrs. Negretti and Zambra, so that no chemical operation is necessary on the part of the operator.

DANGERS FROM FLIES.

IT is rather an alarming fact that flies are winged agents for spreading infectious diseases and parasitic germs. During the summer the swarms of flies cannot be prevented from setting on any and every object. They may alight on the expectorations of a consumptive patient, or on the ejecta of a sufferer from typhoid fever, and the next minute they may visit the moist lips or eyes of a healthy human being. Their feet, mouth, and breast have been in contact with an infected mass, and they convey their poison to the fresh and moist mucous membranes which are ready to receive it. In Egypt, which is literally infested with flies, diseases of the eyes are alarmingly carried by these winged emissaries to the infant natives.

The ejecta of the flies themselves are a source of extreme danger in conveying disease. Every housekeeper is irritated in the summer time when she sees the mirrors and gilt frames spotted with the ejecta of the flies. But Dr. Grassi, the celebrated Italian physician, has by his experiments increased this irritation into alarm. Between his laboratory and his kitchen there lies a courtyard about forty feet in breadth; on a plate on the table of his laboratory he placed a large number of the eggs of a human parasite. After a few hours he found, on some white sheets of paper hanging in the kitchen, the well-known spots produced by the excreta of flies. These spots he examined with a powerful microscope, and was astonished to find there several eggs of the parasite which he had placed on the plate in his laboratory. These had been conveyed by the flies over the forty-feet courtyard, and after passing through their bodies, had been deposited—undestroyed—on the white paper in the kitchen.

Dr. Grassi then caught some of the flies which were entering the kitchen window, and, on examination, he found in their intestinal tract several of the eggs of the parasite. Though satisfied with the result of his experiment, he was alarmed at the risk which his family would run, for it was practically impossible to keep all articles of food from being touched by the flies.

He next took some of the ripe segments of a tape-worm, which had been in spirits of wine, and broke them up in water containing sugar, so that a great number of the eggs remained suspended in the fluid. The flies, attracted by the sugar, came to the mixture, and in about half an hour the eggs of the tape-worm were to be found in the excreted spots and in their intestinal tracts. If these eggs had been in a recent and living state, they would doubtless have been just as easily carried. If any of our readers wish to try an easy and safe experiment, get some lycopod powder, mixed with sugar and water, and after exposure to the flies, the spores of the lycopod will be soon found in the excreta, and easily detected by a common magnifying glass.

It is very plain, then, that if the mouths of the flies will admit of the introduction of such eggs and spores, there will be no difficulty in their admitting scores of the spores of parasitic fungi and eggs of parasitic animals. This is an alarming source of spreading disease. Dr. Grassi has detected in fly excreta the spores of the parasite which is so fatal to the silk-worm.

Some may think that the only real danger is from the conveyance of the eggs and spores by the mouth, breast, and feet of the flies. They may imagine that the active digestion in the intestines of the flies will destroy the vitality of the germs which have been swallowed. But Dr. Grassi is of opinion that in many instances the larger bodies swallowed do not serve as objects for assimilation, but are got rid of, undigested, as foreign bodies. He draws this conclusion from the fact that the flies themselves fall victims to the growth of a parasitic fungus, which is first taken into their own stomachs.

Such facts should be laid before the sanitary authorities of our towns and villages, in the hope that every precaution will be taken to minimise the possibility of the transference of disease by the winged emissaries. No doubt our modern sanitary arrangements have been vastly improved; and Britain cannot be put in the same scale with Italy for the filth which engenders the enormous swarms of flies. Yet the dangers to be apprehended from the flies are possibly to be encountered here, though in a less degree; and the investigation of these facts should be carried on by sanitary officers, with orders to report the results of their experiments.

Again, a distinguished surgeon, Dr. Finlay, of Havana, has lately broached a theory corroborative of this—viz., that mosquitos are actually spreaders of yellow fever. His theory is that the sting of the insect, after penetrating the skin of a yellow-fever patient, retains on its exterior the germs of the disease, which may thus be conveyed to the next person it attacks. As a result of his investigations on the subject, carried on with great care and untiring zeal, this observer found that every mosquito that stings will probably deposit its inpregnated eggs within a few days after its bite, provided it can find water in which to deposit them. From these eggs the young mosquitos will be developed in about three weeks. As the eggs are deposited in the locality where the mosquito stung its victim, the young would also be produced there; and, finding the yellow fever patient near by, would sting him, become infected, and carry the germs to other human beings. In fact, Dr. Finlay believes that yellow fever is not transmitted through the air, nor by contact, but only by inoculation, largely by means of the mosquito. He regards the disease as incapable of spreading wherever tropical mosquitos are not found; that it ceases to be an epidemic at the same limits of temperature and altitude which check the enemy's existence; and that it spreads wherever the mosquito abounds. In confirmation of his views, he reports that, in the summer of 1885, mosquitos were scarce in Havana, but were very numerous in the autumn; and that, although the summer was unusually hot, yellow fever cases were few in number; but in the autumn these increased to an alarming extent. It is humiliating for us to see how we frail creatures are surrounded with so many sources of disease.

THE DRIFTLESS AREA OF THE UPPER MISSISSIPPI.

PERHAPS some reader may require to be reminded that by the term "*drift*" geologists mean a layer of large and small blocks of stone, angular or rounded, mixed with sand or clay, heaped irregularly over the other rocks, and to be traced over much of Northern Europe and North America.

Now among the many interesting results of the United States Geological Survey, one of the most striking is the discovery of a tract of about 10,000 square miles in the basin of the Upper Mississippi free from the drift This island, or oasis as we may call it, is most singular in its character. To find some mighty mountain, which. had towered above the great sheet of ice which overspread the region in the glacial age, and which had thus escaped the deposit of drift, would create no surprise. Nor should we think it strange if a table-land near the border of the area of drift had stood out above the invading ice. But here we find a broad tract, lying in the very valley of the chief river of the region, overlooked by higher land on different sides, and yet remaining untouched by the glaciation. What is most curious is that the margin of the drift, nearly on all sides, lies on a slope *descending* towards the driftless region. The drift-bearing ice was checked in its course, not by some steep ascent which it could not surmount, not by some great structural barrier, but by some different agency which arrested it on its downward course. Around it spread the drift to the extent of 340 miles to the west and south, and to a greater distance northwards and eastwards.

The driftless territory is rudely four-sided in its figure, and it extends over several distinct geological formations. As compared with the adjacent drift-covered regions, this area is remarkable for the absence of waterfalls and the rarity of constricted gorges. One of the most decisive proofs that the region has never been invaded by glaciers, is to be found in the fragile pinnacles of rock which abound over the northern portion of the district. It is inconceivable that a great ice field should have swept ouer the region without rounding off the rocks or entirely overwhelming the more slender forms.

The principal features in the history of this driftless area seems to have been an extension of the glaciating agencies from the north around both sides, and their rejunction below it. The second event would be the partial deglaciation of the region to such an extent as to permit the growth of vegetation over its surface. Not indeed that it was a dense forest region, but it was still clothed with trees.

The third event was a reglaciation, which spread over Northern America, a covering of ice even deeper than that in the first stage. Then followed a long period of freedom from glaciation, giving place to a fresh inroad of ice. After the cessation of the glacial inundations, the rivers carved the diluvial plains into terraces.

We have now to raise the main question, *i.e.*, how the driftless area escaped the repeated glaciations which desolated the surrounding country? The very fact that the glaciation of the surrounding country was repeated is very significant, proving that the immunity of this area was no mere fortuitous incident. The cause must have been a constant one, warding off each successive attack of the ice-fiend.

It cannot, as we have seen, lie in the elevation of the area, unless it was during the glacial period of a decidedly greater altitude than at present, for which there is no evidence.

As far back as 1877 Professor Winchell pointed out that the driftless area lies in the lee of the elevated territory of Northern Wisconsin and Michigan, which, he maintained, acted as a wedge, forcing the ice aside, and so protecting the driftless portion in its rear. Professor Irving, about the same time, argued that the great valleys of Lake Superior and Lake Michigan lie in such a position with respect to the driftless area as to divert the ice streams to the right and left, and that this, in connection with the highlands lying between the lakes, turned the ice away. Mr. Strong, on investigating the lead region in the centre of the district, advanced a similar opinion.

But these considerations scarcely meet all the difficulties of the case. Other causes, not as yet distinctly formulated, must have come into play.

It remains to inquire whether, in addition to the topographic influences, climatic causes may have come into play? Were there any special climatic influences which favoured the wasting of the advancing ice-currents? None have been traced as specially inherent in the region. Neither the rainfall, the cloudiness, nor the winds are notably greater or less in this area than in the adjacent ones. Climatic charts show local variations, but these are not conterminous with the area in question, nor with *the wastage area in which the threatening glaciers were consumed.*

Messrs. T. C. Chamberlin and R. D. Salisbury, the geological surveyors, remark that the law of the self-perpetuation of climatic conditions was doubtless effective. Just as there can be little doubt that the ice-clad regions increased the snow-fall upon themselves, and tended to self-perpetuation, so the ice-free area by warmth, and therefore relative drought brought back the advancing ice. At the time when it was most threatened—when the ice seems to have completely surrounded it—a special action may have come to its aid. The prevailing winds, coming as at present from the south-west, as they encountered the ice-belt on the west and south of the area, were freed from their moisture by the cooling effects of the ice and of their ascent of the western slopes of the glacier. As they descended on the east side they regained their capacity for moisture, and became dry and absorbing winds, and the extent of the area may not have been sufficient to saturate them again before they encountered the ice upon the southern or eastern frontier. But the explorers hold that the primary causes were topographic, climatic agencies playing merely an auxiliary part.

INFLUENCE OF SEASONS UPON VEGETATION. — According to *Le Voltaire*, last year the buds of the chestnut opened on April 19th. This year they have appeared on the 20th, their mean being the 15th. For their flowers and those of the lilac to open, the mean temperature must have reached 53° Fahr., and the maximum 63° Fahr. Wheat, in order to spring up, requires an accumulated temperature of 302° Fahr.; to produce ears, 2,426° Fahr.; and to ripen, 4,000° Fahr. Barley makes lower demands, an accumulation of 3,270° being sufficient to bring it to maturity. The vine demands 5,250° Fahr., setting out from 50° Fahr. as a lower limit. The date tree requires, to ripen its fruit, an accumulated temperature of 9,000° Fahr. Butterflies do not issue from the chrysalis until the mean temperature exceeds 58° Fahr.

THE HOMING "INSTINCT."

MUCH attention has been drawn lately to what is called the "homing instinct," or, more correctly, the "homing faculty," by which certain of the lower animals are enabled to find their way through trackless deserts, over the seas, and even in regions which they have never visited before. The facts of the case—and facts there undoubtedly are—have been much overclouded with exaggerations and distortions. All such superfluous matter must be ruthlessly stripped away before any scientific explanation can ever be attempted. This is a task which, for very obvious reasons, cannot be undertaken within our narrow limits. New observations are called for, no less than a critical revision of such as have already been recorded. All we can do at present is to clear out of the way a few preliminary errors.

In the first place, the power of track-finding without any landmarks manifest to our ordinary senses is not confined to the lower animals, or to any of them, but extends to man also. Dr. B. Moritz, in the *Verhandlungen der Gesellschaft fur Erdkunde zu Berlin*, states that the Ma'dân of the swamps of Mesopotamia possess in a most remarkable degree the faculty of "orientation," *i.e.*, of finding direction. He writes, "We wonder how the Bedouins, who in the trackless desert, even in parts where a European fails to recognise any land-mark, contrive to find their way correctly, and we forget that this faculty is by no means common to all the Bedouins, but the power seems to be much more highly developed among the Ma'dân. Whilst the Bedouin in the desert has at least an open view on all sides, and can recognise any special feature of the district, be it far or near, the Ma'dân, almost up to the neck in water, is surrounded on all sides by reeds and sedges, often yards in height, and which are constantly changing their appearance."

Yet these people even in the night find their way with safety among the thickets of water-vegetation and amidst a net-work of deep channels.

Here, then, is a problem for lovers of the marvellous. We have surely no right to assume that these Ma'dân possess a "magnetic sense," like that which has been attributed to birds. We find them endowed with the same organs of sense and the same mental faculties as ourselves, though doubtless cultivated in a different manner. Their sight, and above all, their disposition and power to observe closely and accurately, have been developed by the experience of successive generations, whilst in us the same faculties have been dulled by generations of town life, and by the habit of drawing all our knowledge from books. But in these deserts of water, mud, and reeds, how little of a permant nature is there to observe. The task of the redskin when tracing a foe through the American forests is much easier.

Another instance of the intensification of the ordinary human faculties, though exerted in a different manner, is given by Mr. E. W. White, F.Z.S., in his "Cameos from the Silver Land." Speaking of the Rastreadores of Rioja, in the Argentine Republic, he writes, "These men will enter a field in the middle of a pitch-dark night, and out of a troop of strange loose mules will unerringly lasso their own, and march them off, distinguishing those that occupy their several places in the team. Although I have had considerable experience, I never could detect by what sense they were guided."

Thus we see that men possessing the same faculties as ourselves—the burden of proof, of course, devolving upon those who would assign to them any others—can execute tasks which to us civilised, or perhaps, stupefied, Europeans would seem to involve some *Deus ex machina* in the shape of a mysterious "instinct."

With the lower animals the case is different. We know that the senses of some, *e.g.*, the scent of dogs and of moths, or the sight of most birds, are vastly more acute than our own. As regards the Articulata, we may even, without any sin against scientific method, assume that they are endowed with senses of which we are devoid, and of which we can form no direct conception, as facts observed indicate that such is the case.

But acute and painstaking naturalists find themselves more driven to question the infallibility of the "homing faculty." Thus a number of bees have been caught, marked, carried out to different distances at sea, and then and there released. The number which found their way back to the hive near the shore was very fairly proportionate to the distance to which they had been carried, and was much smaller than if the insects had been conveyed away to a similar distance overland, and then set at liberty. This seems to indicate that bees find their way home by the aid of landmarks, which they remember, over the country around the hive, and that where such landmarks are wanting, they are, indeed, at sea. Solitary bees, when beginning to built a nest, have been witnessed apparently noting the position of the nest with reference to two or three prominent objects near at hand, which were evidently to be used as land marks.

The difficulty of "straying" a cat is well known. But few persons when enlarging on the "homing" power of these animals reflect that they are in the habit of exploring the country for perhaps two miles around their homes; at least, we have seen a sleek, domestic cat bird's-nesting at fully that distance from any human habitation. Their habit of climbing trees and sitting on housetops also gives them the opportunity of studying the "lay" of the country.

As for the stories we read of dogs and cats being conveyed to some new destination by rail, or on board a boat, perhaps even enclosed in a basket, and then finding their way back by road, it is difficult to say how far the facts may have been "coaxed."

METEOROLOGICAL OBSERVATIONS IN A BALLOON.—According to *Ciel et Terre*, M. H. Lecoq ascended from La Villette, Paris. A storm coming on, the balloon entered a region of greenish-grey vapours which completely concealed the earth. It revolved continually, ascending and descending without the intervention of the aeronant. Sometimes the sensation of a current of hot air was perceived, when the balloon immediately rose, on one occasion to the height of 5,000 feet. At this height the storm was in full force, and electric discharges were continually taking place between the cumulus in which the balloon was floating and a higher stratum of cirrus. The most striking facts were the very violent agitation of the air and the ascending and descending whirlwinds which were produced in the midst of the electric cumulus.

ANCIENT EGYPTIAN ART.—It is not generally known that the process of depositing copper from its solutions upon metallic or non-metallic objects, was known and practised by the ancient Egyptians. Earthen vessels, figures, points of wooden weapons, and even statues of life-size, coated with a thin layer of copper, have been found in considerable numbers in their tombs.

General Notes.

THISTLE CLUBS.—The *Field* makes the happy suggestion that farmers should form associations for war against thistles on their respective lands and along the adjoining roads, lanes, and waste grounds. This is a case where the proverbial "stitch in time," in the shape of beheading all thistles before they begin to scatter their seed, would save not nine, but nine hundred.

RATS AT EXHIBITIONS.—Exhibitions seem to have a special attraction for these mischievous rodents, which, at Rome, succeeded in breaking up the display of the Pope's Jubilee presents. It is a pity that the Swedish and other inventors who are so prolific in devising schemes for taking human life cannot spare some small share of attention for the destruction of vermin.

A CYCLONE AT MADEIRA.—On May 17th the island of Madeira was assailed by a severe cyclone, which occasioned enormous damage on the north side of the island. Here there fell a water-spout of *salt water*, which has destroyed and sterilised splendid plantations, and occasioned extreme misery. *Cosmos* remarks that this fact has a very important bearing upon the theory of cyclones.

THE TREATMENT OF SEWAGE. — M. Pasteur has energetically combated the project to turn the sewage of Paris upon the land at Achère. He bases his arguments upon the possibility of the transmission of virulent and contagious maladies by microbia. His arguments have been supported by the eminent chemists Schloesing and Schützenberger and by the distinguished physician Armand Gautier.

THE ARTESIAN WELL AT BARCALDINE (QUEENSLAND). —This well, which has only taken a month in boring, and cost merely £800, has encountered a good sheet of water at a depth of about 200 yards. The water, which is very clear, rises to the height of four yards above the surface of the soil. The hourly yield is about 7,300 gallons; the temperature is about 100° Fahr. The value of the surrounding land has been doubled.

A DISINFECTANT OF THE AIR.—According to M. Keldyche, who has published of his experiments in the *Russkaia Medizina* (quoted thence in *Cosmos*), the air of hospitals, if saturated with eucalyptol, does not give rise to the development of colonies of bacteria upon gelatine. Moulds are still produced, but the action of the latter upon the higher animals—though not sufficiently studied—appears to admit of being neglected. Eucalyptol appears, therefore, to be a powerful disinfectant of the air.

THE GOOD AND ILL OF DEW.—The *Popular Science Monthly* remarks that dew is known to play an important part in the growth of plants by furnishing them with moisture. In hot and arid countries and seasons plants could not reach maturity were it not for the dew. M. Prillieux, however, shows that dew plays a mischievous part in promoting the growth of parasitic fungi, whose spores, brought by the wind, owe to it the power to germinate wherever they happen to light.

TEMPERATURE OF THE MOON.—Mr. J. Ericsson (*Cosmos*) has constructed a very sensitive instrument for measuring heat. It consists of a thermometer bulb enclosed in a vessel of bronze containing a parabolic mirror which throws the rays upon the bulb. The bronze vessel is enclosed in another recipient containing water. According to experiments made with this apparatus the temperature of the moon is not -223 degs. F. (equal 255 degs. of cold), but cannot be lower than -148 degs. F. (equal 180 degs. of cold).

DISCOVERY OF CHLOROFORM.—The *Popular Science Monthly* attributes the discovery of this compound to Dr. S. Guthrie. He seems to have published an account of his discovery in *Silliman's Journal* for October, 1831. The paper was in the printer's hands prior to May 8th, 1831, and he had been experimenting with the substance for six months. Liebig's work on the subject was, according to his own statement, completed in November, 1831, and Soubeiran's memoir did not appear until January, 1832.

DATE OF THE LAST GLACIAL EPOCH.—Supposing that the glaciation of the northern hemisphere depends on the coincidence of the earth's perihelion with the summer solstice every 21,000 years, M. Adolphe d'Assier calculates that the last glacial epoch came to its height in 9250 B.C., and that the intervening period of greatest warmth in the northern hemisphere culminated in A.D. 1250. Since that date we have experienced increasing cold, and the next glacial epoch will be at its height in A.D. 11750.

VISUARIES AND AUDITARIES.—Certain French psychologists divide mankind, intellectually speaking, into "visuaries" and "auditaries." The first class receive knowledge most readily through the eye, and express themselves best in writing. The auditaries, on the contrary, learn most readily through the ear, from lectures, speeches, sermons, and conversation, and express their ideas best by word of mouth. Men of science and industrialists are for the most part "visuaries"; divines, lawyers, and politicians are generally "auditaries."

THE DIRECTION OF MOUNTAIN CHAINS.—M. Marcel Bertrand (*Comptes Rendus*) remarks that winding chains and folds are in reality almost as frequent as rectilinear chains. M. Suess has shown that the Carpathians, the Transylvanian Alps, and the Balkans form a single chain, the outline of which is an inverted S. The Swiss, French, and Ligurian Alps, the totality of the Sierra Nevada and the Atlas, the partially submarine chain of the Antilles, furnish examples not less striking. It remains to be determined what causes thus deflect at certain points the waves of the earth's crust, whilst allowing them elsewhere to extend in a rectilinear manner.

THE "HUMMING" OF TELEGRAPH WIRES.—This phenomenon has its practical disadvantages. In Norway the bears attracted by the sound sometimes dig up the posts, hoping to find a bees' nest with a hoard of honey. But the cause seems hitherto a mystery. Wind? It is most often and most distinctly heard on calm, clear evenings. Electric currents? But it is observed when the wires are not conveying any currents and when the most delicate instruments fail to detect electric action. Does it depend on the direction of the telegraph line with

reference to the magnetic meridian? Is it a result of changes of temperature?

Cosmic Actions upon Telegraph Wires.—There exist on the surface of our globe electric and magnetic currents, manifested by their influence upon telegraphic lines, especially if submarine. It is suspected that these currents pass through two maximum and two minimum points within every twenty-four hours, and a connection is supposed to exist between these currents and the solar spots. We learn that during the eclipse of the sun on August 12th last the electric currents in the line from Vladinostak to Nagasaki were normal at the beginning of the eclipse, increased twofold during its continuance, and then returned to their normal condition.

The Sense of Taste.—Messrs. Bailey and Nichols (*Science* and *Revue Scientifique*) have made interesting researches on this sense, the delicacy of which differs respectively in the two sexes. Women perceive the presence of sulphate of quinine in a solution containing 1 part in 456,000. Men recognise it only in a solution of 1 part in 392,000. The same difference is perceived in other cases, except for saline flavours. Women detect sugar in solutions of 1 in 20, of acids in solutions of 1 in 3,280, and of alkalies at 1 in 129. Men detect these tastes respectively at the strengths of 1 in 199, 1 in 2,080, and 1 in 98. Saline tastes are detected by men in solutions of 1 part in 2,240, whilst women require a solution of 1 in 1,980. These values represent the means of numerous experiments made upon 46 women and 82 men. The taste is evidently more sensitive for bitters than for any other flavour.

Novel Application of Portland Cement.—Mr. Wilson, of West Thurrock, Essex, has succeeded in applying Portland cement to a variety of novel and useful purposes, by the simple expedient of allowing it to solidify around a core of iron wire. In this manner he has succeeded in producing not merely slabs for sinks, urinals, stair-treads, etc., but telegraph-poles. These have been constructed of the length of 25 feet, and so free from brittleness that they may be bent a foot out of the perpendicular without crumbling or breaking. For this use, as well as for gate-posts, the uprights of fences, etc., this material has the advantage of being proof against the attacks of insects and fungi, dry rot and the like. As the uprights can be made with holes at any height for the insertion of the horizontal bars, fences on this principle can be put up much more quickly and cheaply than wooden fences.

The Paris School of Mines.—The laboratory of this school, which was characteristically suppressed during the first French Revolution, and re-established on the convalescence of the nation—has been exceedingly active during the last twelve months. The number of samples of ores and other industrial minerals established has reached 989. We notice that some specimens of mercury ore have come to hand from Tunis, and others from the Sierra Nevada in Grenada, a locality perfectly distinct from Almaden, which is at present the chief source of mercury.

Samples of chromium have been obtained from Gravaha and Marmaritza, in Asia Minor; and one specimen of cobalt from a place in the Caucasus bearing the unutterable name of Bkhseni. Ores of bismuth have been examined from Leon, and auriferous minerals from Spain, from Tonkin, Mexico, Guatemala, Ecuador, Venezuela, Brazil and Patagonia.

Testing the Ocean Currents.—The Royal mail steamer *Kinsembo*, of the British and African line, which has arrived at Liverpool from the West Coast of Africa, is the bearer of an interesting message from the sea. The message in question was contained in a bottle, and had been drifting in the ocean since March last year. It appears that the Deutsche Seewarte of Hamburg arranged with various captains to despatch messages from different points at sea in order to ascertain the strength and direction of ocean currents. When the *Kinsembo* was at Baffon Bay, on the West Coast of Africa, a native Krooman handed Captain Hartje a piece of paper which he had taken from a bottle washed ashore on that part of the coast. The paper was in a very good state of preservation, and had been thrown overboard from the German barque *Pencho* on 26th March, 1887, in lat. 5.17 N., long. 30.37 W. The *Pencho* was going from Hamburg to Pisagua. It requested the finder to return the paper to the Deutsche Seewarte, stating its condition and where found. The bottle had drifted about 1,200 miles in a little over twelve months, as it fell into the Krooman's hands on 2nd April. The captain of the *Kinsembo* has forwarded the message to Hamburg, in accordance with the request mentioned in it.

Vivisection.—A Parliamentary paper, issued by the Home Office, was published recently containing a report showing the number of experiments performed on living animals during the year 1887, under license, distinguishing painless from painful experiments. The total number of persons licensed to perform such operations in England and Scotland was 82, all (save one foreign graduate) graduates of a British University or Fellows or members of Royal colleges. Of these 64 exercised their right. The buildings where such experiments are allowed to be made are 26 in number—nine in London, nine in the provinces, eight in Scotland. The number of experiments was 1,220, of which 582 were performed without anæsthetics. These were, with very few exceptions, simple inoculation experiments, and were consequently painless. The experiments were—physiological, 237; pathological, 703; and therapeutical, 280. The number of cases in which pain has been unavoidably inflicted during experiments conducted under certificates dispensing with anæsthetics, or with the killing of the animal on recovery, was 71, two being physiological, 21 pathological, and 48 therapeutical. Comparatively few vivisections properly so called—that is, involving a distinct surgical operation on a living animal—were practised during the year. In all cases in which such experiments have been performed under the certificate dispensing with the slaughter of the animal before recovering consciousness, it has been made a condition that the wound should be rendered painless by antiseptic treatment, and, that failing, the animal should be destroyed. This condition has, the inspector believes, been faithfully fulfilled. The animals on which pain was inflicted were two cows, 12 calves, one cat, 32 rabbits, and 24 frogs. In Ireland there are only four persons licensed, and the experiments, 11 in number, were all painless.

THE "POLYPARIUM AMBULANS."

A NEW and perplexing marine animal has been fished up in the waters of the Malay Archipelago. *La Nature*, from whom we borrow the accompanying illustration, gives as its locality the strait separating the islands of Mindanao and Billiton. Here we suspect some clerical or typographical error, since the two islands are at a distance of more than 1,000 miles from each other, with the huge island of Borneo intervening.

A Dr. Korotneff, who appears to have been the discoverer, states that on taking this creature out of the dredge it seemed like a slimy ball, about the size of a chestnut, and of a yellowish-grey colour. It was marked with spiral circumvolutions, and covered with

FIG. 1.—*Polyparium ambulans* creeping upon a branch of Gorgona, which serves as a support for a specimen of *Tubularia parasita*. Twice the size of life.

little tubercles. On putting this substance into a glass it uncoiled, the ball became a kind of fillet of a certain thickness; the tubercles displayed each a mouth-like orifice, and the entire body began to crawl up the sides of the glass.

In Fig. 1. is a representation of the *Polyparium ambulans* creeping on the branches of a Gorgona of the same locality, with which there is frequently associated a new species of polype to which Dr. Korotneff gives the name of *Tubularia parasitica*. This figure shows that the surface of the Polyparium, which is turned inwards when the animal is coiled up, is very different from the other. It is upon this surface that the animal creeps; it recalls somewhat the "foot" of a snail, and still more of a creeping Holothuria, and may be considered as a ventral surface. This surface is marked by two longitudinal furrows, which divide it into three parallel bands, the two external being each only half the width of the intermediate. These two lateral bands are not exactly alike, so the animal is not symmetrical. The intermediate band shows series of air-holes, each exactly opposite to one of the nearly spherical tubercles on the dorsal surface. The correspondence of the dorsal tubercles *t* and the ventral apertures *r* is shown plainly in Fig. 2, No. 1, which represents a vertical and longitudinal section of a small portion of the Polyparium. In this section we perceive that the band which forms the body is hollow, and that the cavity is divided into successive chambers, *l*, by transverse partitions, *c*,

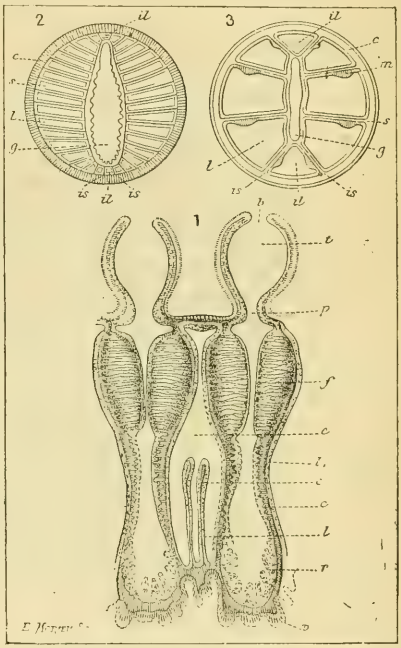


FIG. 2.—No. 1. Vertical section through two cells of *Polyparium*: *b*, mouth; *c*, septa limiting the transverse cells; *c*, interval between two consecutive cells, in which are two septa in course of formation; *l*, cavity of the transverse cells; *f*, thickened transverse bands; *p*, pharynx; *t*, cavity of the tubercles; *r*, entodermic folds; *v*, air-hole. No. 2. Transverse section through the upper region of a sea-anemone of the genus Oerianthus. No. 3. Transverse section of the upper region of a coralline approaching *Alcyonium*; *c*, wall of the body; *l*, lateral cells, even and symmetrical; *il*, odd cells; *is*, septa between the cells; *g*, digestive tube.

arranged like those which separate from each other the segments of the body of an annelide worm. But there exists an important difference. In an annelide worm the partitions which succeed each other separate chambers, which all resemble each other, and their two surfaces are approximately identical. But here the par-

titions have their two surfaces respectively *unlike*, and they are arranged in pairs, turning their similar surfaces to each other, and thus limiting transverse chambers (Fig. 2. No. 1, *l*), separated from each other by empty spaces (Fig. 2, No. 1, *e*). Into the chambers *l* there open at *p* the hollow tubercles *t*, whose cavity communicates with the exterior by means of the dorsal orifices *b* already mentioned.

If we consider merely the general form of the body and the regular repetition of the vertical septa, we might take the *Polyparium* for a worm. But if it were a worm a digestive tube would traverse all these partitions, and would vent externally by a single aperture. There is here nothing of the sort. The digestive canal is totally wanting. The walls of the chambers serve to digest alimentary matters, and these matters can be ingested only by the orifices of the dorsal tubercles. These orifices must consequently be regarded as so many mouths.

Now, in the whole animal world the sponges and the polypes are the only forms in which the sides of the body subserve digestive functions, the entire body being thus a kind of stomach. The Polyparium must therefore, in spite of its worm-like aspect, find its place among the zoophytes. But a very definite feature separates the polypes from the sponges—*i.e.*, the presence in the external layer of the integuments of the former of innumerable capsules filled with a venomous liquid which can penetrate into the bodies of animals with which they come in contact.

This is the cause of the sensation of burning experienced on touching the large sea-anemones and the *Medusæ*. The side of the body of the *Polyparium* is covered with these irritating capsules. Hence the *Polyparium* is a polype, and a close study of the sides of its body assigns it a place very near to the *Actiniæ*.

Still, the aspect of the *Actiniæ* differs very decidedly from that of the *Polyparium*. An *Actiniæ* might be likened to a flower which has no stem, whose petals are animated and arranged in concentric circles around a central orifice, which is the mouth of the animal. The petals of these movable flowers are called tentacles. Fig. 2, Nos. 2 and 3, represents transverse sections through the body of two such *Actiniæ*—an Alcyon and a Cerianthus. In this figure, the central ellipse, *g*, is the section of a tube opening downwards, which is a continuation of the mouth, and which some regard as a stomach and some as an œsophagus. The radiating chambers, *l*, follow each upon a tentacle, and may be regarded as prolongations of the tentacles into the interior of the body. As the œsophagus is in general much shorter than the body, the partitions which separate the cells become free on the inner side, and the cells all open into the internal cavity of the body. One and the same septum is common to two consecutive cells.

In the *Polyparium* there is no œsophagus; the cells do not communicate with a central cavity, but are completely separate from each other. The transverse partitions (Fig. 2, No. 1, *c*) belong not to two consecutive cells, but each cell has its own walls, separated from each other by a vacant space (Fig. 2, No. 1, *e*).

The difficulty decreases if we agree with M. Korotneff that the cells of the sea-anemones are arranged symmetrically on each side of two odd cells (Fig. 2, Nos. 2 and 3, *il*). If the œsophagus disappears, and if the septa are prolonged to the centre of the polype, they must meet two and two, become fused together, and constitute an organism having some analogy to the *Polyparium*. There are corallines, such as the *Meandrinæ* and the *Dendrogyra*, in which the cells are disposed on either side of long, winding galleries, on either side of which are numerous mouths. Dr. Korotneff thinks that the *Polyparium* is the equivalent of one of these galleries. It may be regarded as a Meandrina without tentacles and with numerous mouths, arranged in a great number of transverse series, instead of in a single longitudinal series.

Dr. Ehlers views the tubercles of Polyparium as tentacles provided with mouths. In some cases the tentacle may become abortive, and the mouths remain alone. But, according to M. Edmond Perrier, the interpretations of Dr. Korotneff and Dr. Ehlers are really identical. As the flower is merely an assemblage of modified leaves, the coralline polype is merely as assemblage of more simple polypes, soldered together and forming an association in which the functions are distributed.

VEGETATIVE MODIFICATIONS OF PROTOPLASM.

IN the *Comptes Rendus* for June 13th, 1887, Dr. A. P. Fokker showed that the protoplasm of an animal recently killed, protected against microbia, set to digest on the stove in a solution of sugar and starch, converts the sugar into acid, and the starch into sugar, these chemical changes being effected without the intervention of microbia.

Shortly afterwards the same experimentalist made a further communication to the effect that blood-globules, if digested in a nutrient medium, slightly acid, undergo very remarkable changes and give rise to a sort of vegetation to which Dr. Fokker has given the name haematocytes.

On further pursuing his experiments he has found that chloroform, which, as it is well known, suppresses the development of microbia, but does not act upon the so-called non-organised ferments, is a very safe agent for demonstrating, on the one hand, the absence of microbia in the actions of protoplasm, and, on the other, that the formation of haematocytes is a vegetation, and not, as has been pretended, a mere coagulation.

If we take from any animal recently killed a particle of protoplasm, place it in a solution of sugar or starch, adding a little chloroform, and set it to digest in a stove at 98° F., we find, after a few days, that in the solution of sugar there has been formed acid and in the solution of starch, sugar, and that, although no antiseptic precautions have been taken, yet that microbia are absent.

If we mix in a test-tube two or three drops of blood from a prick of the finger, add 5 cubic centimetres of a non-neutralised solution of extract of meat, at $\frac{1}{4}$ per cent., and let it digest in the stove at 122° F., after a few hours there are produced haematocytes. But these haematocytes will not be produced if we add a few drops of chloroform.

These experiments prove that protoplasm combines to the property of producing fermentations that of undergoing vegetative changes, and corroborates the opinion already expressed that the formation of haematocytes is a case of heterogenesis. It is not, however, on that account a case of true spontaneous generation.

LEPROSY IN RUSSIA.—According to the *Medical Press and Circular* leprosy is increasing in Russia, especially in the Baltic provinces. At Riga a special hospital for lepers has just been opened.

Natural History.

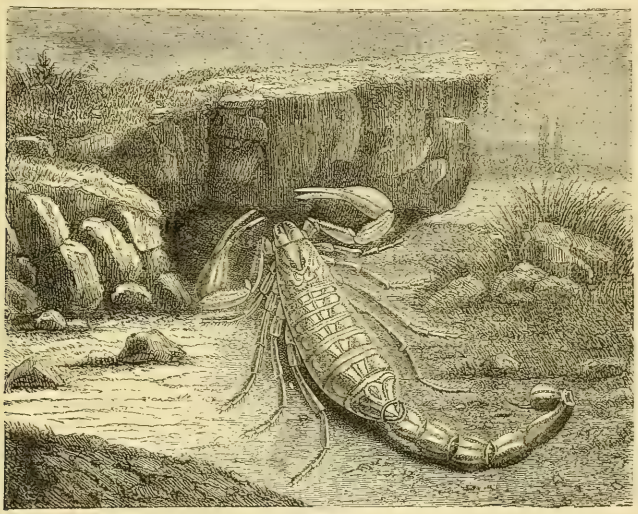
THE STING OF THE SCORPION.

One of the most singular of all poison-bearing weapons is that curious curved claw which we find at the extremity of the tail of the scorpion; and it is particularly remarkable in this, that it is a special weapon situated upon a special appendage, and not a modification of some bodily member which ordinarily serves a different purpose. In this respect it differs from all other weapons of its class. The fangs of the venomous serpents are merely modified teeth; the stings of the bee, the wasp, and the hornet are modified ovipositors; the poison-jaws of the centipede are modified legs; the formidable spines of the weever fish and the sting ray are modified fins. And so on. But in the case of the scorpion it is not so. The tail, so far as we can ascertain, is primarily and finally an organ with one special office to perform, the claw-like sting itself to be primarily and finally a poison-bearing weapon. Neither seems to be a modification of any member which we are accustomed to find in allied animals in a different form, neither appears to have any supplementary duties to fulfil. Both the tail and the claw which terminates it are peculiar to scorpions alone, special organs provided for a special purpose, and unique both in character and in structure. For in more ways than one is the sting of the scorpion a curiosity, and a curiosity well worthy of a somewhat detailed examination.

In the first place, its very position at the end of the body necessitates a considerable prolongation of the tail which bears it; the poison-claw of a scorpion situated at the extremity of such a body as that of a spider would be absolutely useless. For the prey, in order to be struck with the sting, must first be seized and held, by the two great claws into which the maxillary palpi or feelers, are modified; and this obligation implies that the victim, at the moment of receiving the wound, must be in front of the body, whereas the sting is at the back. Hence the necessity for a long and flexible tail, which can be bent over the back when required, and bring the point of the weapon which it carries slightly in advance of the head.

The terminal joint, again, which bears the sting, must be endowed with great flexibility and muscular strength, in order that its stroke may be both certain and effectual; for many of the insects upon which scorpions feed so largely are clad in coats of shelly mail, and the joints of their armour, so to speak, must be discovered before the fatal puncture can be inflicted. Hence the necessity for flexibility, while that for muscular strength is due to the fact that even the membranous hinges, which in such insects connect the various portions of the shell-like covering, are often extremely tough and leather-like, so that a successful puncture can only be brought about at the expense of some little muscular exertion. And even the most casual examination of the tail will suffice to show the admirable manner in which both these qualities are secured, the terminal joint playing upon the penultimate with almost as much freedom as if a ball-and-socket joint were provided, while the muscles which control it are wonderfully well developed, and enable it to deliver a stroke of no little force.

Finally, the supply of poison must be both potent and extensive, for the victims upon which the scorpion preys are for the most part very small, and the tail with its deadly claw is consequently called into frequent requisition. And, indeed, almost the whole of the terminal joint—always propor-



The Scorpion.

tionately very large—is occupied by the venom-reservoir, which even in a dead and dried specimen not more than four inches in total length equals a grain of wheat in size, while in the living animal it is naturally very much larger. And the strength of the poison is very considerable, although varying, of course, in accordance with the size of the individual. Thus the sting of one of the small European scorpions is little more formidable than that of a wasp or a bee, while, on the other hand, the large tropical species are fully as dangerous as a viper, their sting not unfrequently resulting in death. Yet there is a strange peculiarity about their poison—possibly common to all poisons, of whatever nature or whatever degree—which causes its efficacy to diminish in exact proportion to the frequency with which it has been introduced into the system of the recipient. In other words, the first sting produces symptoms far more serious than the second, the second than the third, and so on until the vanishing point is attained. This fact has been conclusively proved by actual experiment, a well-known investigator permitting himself to be stung again and again, until his system became so habituated and inured to the effects of the poison that at last he suffered no more than the mere transitory smart occasioned by the actual puncture. And others who, although involuntarily, have more than once been stung, seem to unite in asserting that the first experience is invariably the most severe.

The orifice in the sting through which the venom enters the wound is double, and is situated slightly above the point, just as is that in the poison-fang of a snake. In shape each perforation resembles the eye of a very fine needle, too small, in most cases, to be visible by the unassisted eye, but apparent enough when the aid of an ordinary pocket lens is called in. And the muscular system in connection with the venom-sac is so arranged, that the pressure thrown upon it by the employment of the sting causes a drop of the liquid to flow into the channel with sufficient force to carry it through the double orifice, and into the blood of the victim.

Does the scorpion ever employ its weapon against itself, and become under certain circumstances a suicide? Tradition asserts that it does, but tradition is often wrong; and wrong it appears to be in this particular instance. For all analogy tells against such a supposition. The venom of a viper or a cobra, for example, is entirely without effect when introduced into its own system, or into that of another of its own kind; why, then, should that of a scorpion prove fatal under similar circumstances? The structure of the tail, again, renders such a proceeding an operation of the utmost difficulty, if not an utter impossibility. Let the investigator examine the tail of a recently-killed scorpion, and he will find that, bend it as he will—of course within its own natural limits—the point could scarcely, by voluntary exertion on the part of its owner, be forced to enter the body. Once more, the shelly mail which covers the body of the scorpion is far too hard and thick for the claw readily to penetrate, while the membrane which connects the joints is extremely tough and leather-like, and scarcely likely to be pierced by the sting if employed in any ordinary manner.

But, say eye-witnesses, we have *seen* scorpions so sting themselves, and they will always do so when surrounded by a circle of fire from which they cannot escape. How is this to be accounted for?

Probably by the fact that such observers fancied that they saw just a little more than that which really took place. A scorpion, when surrounded by a narrow ring of fire, would almost certainly die, not from a self-inflicted wound but from suffocation; for the air around him would be so rarefied as to render respiration quite impossible. And, in dying, he would undoubtedly bend his tail over his back as though in the act of wounding himself with his sting; for such, with more creatures than the scorpion, is the ordinary attitude of death. Cocktail beetles, for instance, almost invariably bend their tails over their backs when killed, and earwigs frequently do the same; yet we do not impute suicidal motives to them. Why, then, should we do so to the scorpion?

The fact appears to be that observers have taken a little too much for granted. They have seen results, apparently due to certain causes, and have instantly assumed, without investigation, that no other cause could be possible. They have upheld an absurd theory in the face of all analogy and common sense, and have even attributed to the scorpion under certain circumstances a proceeding which its very structure renders an impossibility. And so into our natural history has crept one of the many errors which still disfigure it, and which must be ruthlessly expunged before we can hope to bring our records into accordance with facts.

Snakes in Burmah.—We find in the *Rangoon Times* some notices of the serpents of the Far East, which would be more valuable if the species could be identified. There are said to be two green tree-snakes, both of which reach the length of three feet. One of them has a head "shaped like the ace of clubs" with a double set of poison-fangs; it is venomous, but not deadly. The other has a wedge-shaped head, and about a foot of the tail is of a purplish green (?); it is not poisonous. After death the bright green of the skin soon fades out. The writer mentions a case of a serpent springing. A small snake, about two and a half feet in length, crossed the road obliquely in front of him. On reaching the lower edge of the road, where was a small culvert, it shot straight out over the edge of the culvert and dropped three or four feet away into a drain.

Mention is made of a large dark-coloured snake, about six and a half feet long, which some boys had caught by the tail and were seeking to drag out of its lair. It made a groaning sound like that uttered by a calf when being tied up for market.

Snakes' eggs are commonly eaten. They have a tough skin like parchment, and the interior is a custard-like mass of the same consistence all through.

The "hpoongyee" snake has alternate bands of light yellow and dark chocolate or ash-colour; each band is three inches broad. The body of the snake is not cylindrical but three-square, and its average length is five feet.

It is commonly said that carbolic acid is rapidly fatal to snakes, even if dropped on the skin. This the author found quite erroneous. Even a large dose given inwardly did not prove fatal in less than half an hour. The strength of the acid is not stated.

Differences in the Milk of Cows.—Mr. H. E. Alvard, of Massachusetts, has recently made a compilation of facts bearing on this subject. He finds that the total solids range from 11 to 20 per cent. The fat varies to a greater extent, from 2 to 12 per cent. The "solids

not fat" are more nearly constant. The fat globules vary in number and in size, from 1-1,000th inch in diameter to 1-250,000th inch. In the milk of Jersey cows the fat globules average 1-5,252nd inch; in the Ayrshire, 1-7,080. In the Dutch and Holstein they are still smaller. Milks differ also in their digestibility.

THE FOSSIL FLORA OF PORTUGAL.—The members of the Geological Commission of Portugal have made some interesting observations (*Comptes Rendus*), which have been communicated by M. Saporta. It is noticed that the first appearance of large mammalia upon the earth coincides with that of dicotyledonous vegetation.

THE LITTLE NECK HARD SHELL CLAM.—This mollusk (*Venus mercenaria*) has, according to the *Field*, been successfully introduced at Golspie, in Sutherland. The attempt is also being made to naturalise the soft-shell clam (*Mya arenaria*). It is considered that these two mollusks will prove a valuable addition to our esculent shell-fish.

VEGETARIAN REPTILES.—With the exception of some tortoises, reptiles are generally found to be strictly carnivorous. Certain lizards, however, such as *Uromastix acanthinus*, *Eumeces aldrovandi*, *Lacerta ocellata*, and *Stellio vulgaris* eat plants. According to the *American Naturalist*, J. von Fischer finds that *Uromastix hardwickii*, a Bengalese species, refuses animal food, but consumes rice, maize, hay, and straw.

THE CUCKOO AND THE HOOPOE.—The notes that we receive concerning the plenty of cuckoos this season remind us that the hoopoe, where plentiful, *answers* the cuckoo. When the latter cries, "cuckoo," the other replies, "poo-poo-poo." Hence, in Eastern Germany, he is know as the "cuckoo's clerk." Were we less given to the wanton massacre of harmless birds we might hear this duet in England.

INFLUENCE OF ARSENIC ON THE COMPLEXION.—Persons who use arsenic as a cosmetic should know that the effects of this poison upon the skin have been recently discussed at the Pathological Society of London, in consequence of a communication from Mr. Jonathan Hutchinson. It is found that it may spoil the complexion instead of improving it, making it muddy and unsightly. It also occasions soft corns in the palms of the hands and the soles of feet.

THE FORMATION OF BARRIER REEFS AND LAGOONS.—Mr. J. L. Wheaton *(Popular Science Monthly)* accepts generally the views of Mr. James Murray on the formation of barrier reefs and atolls. But he considers the formation of interior lagoons to be mainly due, not to the solution and washing out of dead coral by the sea-water, but to the lack of food, all nourishment having been absorbed by the corals of the outer reef before the water reaches the inner parts.

SUBTERRANEAN FISHES.—In the Algerian Sahara there are numerous subterranean lakes in which a number of small fish and mollusks live and multiply; moreover, the artesian wells of the Sahara often throw out fish that are sometimes two inches in length. The governor of the oases of Thebes and Garbes, in Egypt, in 1849, asserted that he took from an artesian well 440 feet deep, near his residence, fish in sufficient quantity to supply his table.—*Scientific American.*

THE RABBIT PLAGUE IN AUSTRALIA.—If the *Australian Times* is to be believed, the Pasteur experiments on transferring chicken cholera to rabbits at Sydney have proved so far unsuccessful.

THE INTELLIGENCE OF THE WOODCOCK.

M. VICTOR FATIO has recently read before the Society of Natural History of Geneva a paper on this subject, which has been reported in *Cosmos*.

In the pursuit of this wading bird (*Scolopax rusticola*) he has repeatedly observed that a wounded bird dresses its wounds, very ingeniously applying down from its plumage to the injured part. According to the nature of the case it either lays a plaster upon a bleeding wound or fixes adroitly a firm bandage around a broken limb.

He one day killed a woodcock which had over an old wound on the breast a large plaster felted of small downy feathers, plucked from different parts of the body, and firmly fixed upon the injured spot by coagulated blood.

On another occasion he found a plaster, made in the same manner, applied upon a wound in the rump.

Twice he has met with woodcocks each of which had on one leg a bandage of feathers closely twined around a place where a bone had been previously fractured. In one of them the right leg above the tarsus was strongly and quite recently bound up with feathers taken from the back and the belly.

In the other the tarsus itself, in a fair way of recovery, still bore the bandage which had held it in position.

The most curious, and at the same time the saddest case which M. Fatio records, is that of a woodcock which had both legs broken by a shot, and which was only found the next morning. The poor bird had succeeded in bandaging both legs, one of them, indeed, for two distinct fractures; but, being obliged to operate in a very inconvenient position, and being deprived of the use of its claws, it had not been able to remove some feathers which had adhered to its beak, and which prevented it from feeding. Though it was able to fly, and though its wounds were admirably dressed, it had died of hunger.

This proof of intelligence in a bird generally regarded as stupid, and which, like the waders generally, has but a very small brain, merits recording in the annals of animal psychology.

It is curious that a much more intelligent bird, the magpie, should have so much less appreciation of surgery. A neighbour of ours, some years ago, had a very clever but exceedingly vicious magpie. Finding it one day in some piece of intolerable mischief he threw at it the first article which came to hand, and broke one of its legs. He therefore caught the bird, fixed some light wooden splints to the broken part and secured them with twine. Mag, however, did not relish the operation. Sitting on the sound leg it held up the other, gazed at it and gave the bandages a good peck, swearing at every blow. The twine was soon broken and the splints removed, with the result that mortification set in, and the unvirtuous bird perished.

We have heard several cases of surgical operations executed by animals, and would recommend this subject for careful observation.

Reviews.

The Origin of Floral Structures through Insect and other Agencies. By the Rev. George Henslow, M.A., F.L.S., F.G.S, Professor of Botany, Queen's College, etc. London: Kegan Paul, Trench and Co.

This work is by no means the least important member of the selection of works—chiefly valuable—which have appeared under the unhappy title of the "International Scientific Series." The author, a convinced evolutionist, declares that from the very first appearance of Darwin's book he felt great difficulty in accepting natural selection as the real origin of species, and, like the elder Darwin, Lamarck, and St. Hilaire, has "looked to the environment as affording a better clue to the source of variations." Natural selection, he thinks, will more readily account for the disappearance of old forms of life than for the origin of new ones. In this view he is supported by unquestionable authorities, such as A. R. Wallace, Dr. Aug. Weismann, Dr. C. Semper, and Dr. A. de Bary.

We may congratulate the author that he has elected to work out the question in the botanical region. Illustrations of evolution, its laws and its causes, have been taken too exclusively from the animal kingdom. Yet, as Professor J. M. Coulter remarks, among plants the case is even more striking. The fertility of hybrids is there far more common, and we find such "interminable intergrading that fixity of species becomes a dream of the past."

The work has, in consequence of its plan, a two-fold character. On the one hand it throws an additional and often very novel light on the origins of modifications in the organic world; and on the other it supplies an assortment of most interesting botanical facts. Much of this latter kind of matter will, however, be imperfectly intelligible to persons not versed in botanical nomenclature. We must be pardoned for feeling a wish that some competent phytologist would undertake to translate these technicalities into English—a task which we are convinced might be effected without any sacrifice of precision and brevity.

The author's starting point was the following simple observation:—"In 1869, when watching a large humble-bee hanging on to the dependent stamens of *Epilobium angustifolium*, the idea first occurred to me that insects themselves might be the real cause of many peculiarities in the structure of flowers. The thought passed through my mind that the way the stamens hung down might perhaps have become a hereditary effect from the repeatedly applied weight of the bees." Working out this idea he comes to a conclusion which we may contrast with the theory of "natural selection." According to this latter hypothesis, "we may suppose that a plant bore seedlings, some of which had, we will say, the corolla accidentally (that means from some unknown cause arising from *within*) larger on one side than the other, and then such a flower, being selected by insects, left offspring which, by gradual improvement through repeated selections, ultimately reached the form it now possesses."

In the other hypothesis, as developed by Professor Henslow, "we suppose that the first impulse came from *without*, being developed by the insect itself; so that the variation, once set up in a definite direction, went on improving under the constantly repeated stimulus of insect visitors, until the form of the flower was actually conformable to the insect itself.

This latter hypothesis, which the author calls that of "constitutional selection," has certain very weighty advantages. It assigns a *direct physical cause* for the incipient change, instead of some accidental or unaccountable variation as assumed on the hypothesis of natural selection. In the second place it does not require the plant to develop an indefinite number of useless changes, to be all discarded in favour of the one or the few wanted. Lastly, as a great number of flowers would be visited on many plants, great numbers of them might yield offspring advancing in the same direction, and there would be no fear of the improved strain being diluted down to the original form. The anti-Darwinian argument of Fleeming Jenkins is rendered completely nugatory.

Some remarks, showing that survival does not by any means necessarily fall to the lot of the "fittest," deserve notice. Says the writer, "Seeds which fall on the circumference of a crowd, or on a better soil than that on which others may happen to lie, are thereby "selected," but it is through no merit of their own; just as out of the thousands of eggs of a salmon a few only escape the jaws of their enemies: so that simply "good luck" plays an important part in determining which shall survive and come to maturity in both kingdoms alike."

We have, of course, not space to follow the author through the systematic development of his hypothesis as shown in the principles of number, arrangement, cohesion, adhesion, secretive tissues, the sensitiveness of plant-organs, the colours of flowers, etc. Still less can we quote the interesting facts which are thickly scattered through the work. But it is one, we think, which no naturalist, be he botanist or zoologist, can read without pleasure or profit.

Proceedings of the Cleveland Institution of Engineers, April 16th, 1888. Middlesbrough: Office of Cleveland Institution of Engineers.

The first subject of the meeting was the "Architects Registration Bill" now being introduced into Parliament The council and members adopted the view of the Institution of Civil Engineers, that the principle of the Bill is to be rejected, as likely to benefit neither the profession nor the public.

The remaining part of the meeting was taken up with a paper on the Stockton and Middlesbrough Corporation Water Works, containing nothing of general interest.

Transactions of the Mining Institute of Scotland. Annual Meeting, April 26th, 1888. Vol. x., part 1.

This issue comprises the inaugural address of the new president, Mr. J. M. Ronaldson. Here some emphasis is laid on the fact that for coal-mining purposes *the* lamp of the future has not yet made its appearance.

A discussion then followed on a system of endless rope haulage in use at the Newbattle Collieries, but the time of the meeting was mainly taken up with an account of Scottish mining legislation in former days. It is not generally known that up to the end of the last century colliers and persons employed in salt-works were in a state of serfdom, bound for life to the establishments where they were employed, and transferable with the collieries and salt-works.

In the abstracts given from other papers, it is mentioned that the deposits of copper pyrites at Huelva had been diligently worked by the Romans, and that with so much skill and judgment that even at the present time a mine bearing no marks of their activity is

generally found worthless. The ores contain from 1 to 10 per cent. of copper, but they are more especially in request as sources of sulphur for the manufacture of sulphuric acid.

Modern Science in Bible Lands. By Sir J. W. Dawson, C.M.G., LL D. F.R.S., etc. London: Hodder and Stoughton. 1888.

In his introductory remarks Sir William Dawson says that the special object of his new work is "to notice the light which the scientific exploration of the countries of the Bible may throw on the character and statements of the book." The author's position as a geological observer of high repute gives authority to his statements regarding matters of geological fact and hypothesis; and his researches are rendered very interesting from their connection with the records of the Hebrew Scriptures; but notwithstanding all the points telling in its favour, we cannot help entertaining the opinion that the book would have been more valuable had its tone savoured less of polemic and controversy. It contains, in fact, too much pseudo-theological argument, and is too obviously a work "with a purpose."

These characteristics prevent our reviewing it in detail, for they necessarily carry it outside the range of ordinary scientific criticism; but we gladly bear testimony to the clearness and felicity of style with which the subject is treated, as well as to the admirable way in which both printer and publisher have done their duty.

A Few Words on Portland Cement. By a Manufacturer. D. L. Collins (of Gibbs and Co., Limited). Second edition. With Appendix on the Relation of Chemical Analysis to Quality in Portland Cement. London and New York: E. and F. N. Spon.

The use of Portland cement in engineering constructions, whether civil or military, has very much increased of late, and is likely to extend still further. The author of this little treatise is evidently the first manufacturer who has made public the results of his experience, showing what conditions are necessary for the production of a thoroughly good quality, and explaining the value and the application of the usual tests.

The scope of chemical analysis is limited, since two samples, one good and the other bad, may differ respectively very little in their percentage composition. It is, however, necessary to ascertain whether the original proportion of lime employed is excessive, and whether any of it remains in the free state, *i.e.*, not chemically combined with silica and alumina. The proportion of carbonic anhydride, or carbonic acid, as it is more popularly called, should never exceed 1·50 per cent. The highest figure we find in the analyses quoted is 1·14 per cent. Any excess of sulphur or of magnesia is also highly objectionable.

Mention is made of a "slag cement," which is a mechanical mixture of ground iron slag with slacked lime. This mixture, which is sometimes sold as such, and sometimes used for adulterating Portland cement, is considered by the highest engineering authorities to be inferior in quality. Directions for the detection of this slag cement are here given.

Mr. Collins deserves great credit for having departed from old rule-of-thumb routine, and for the public spirit which he has shown in laying the results of his experience before the world.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on June 15th the following communications were read:—"The Electric Organ of the Skate," "Structure and Development of the Electric Organ of *Raia Radiata*," by J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by Prof. J. Burdon Sanderson, F.R.S.

The first part of this paper is chiefly devoted to a comparison of the electric organs of *Raia radiata*, *R. batis*, and *R. circularis*. In the first place it is shown that the organ in *Raia radiata* is absolutely and relatively of less dimensions than that of either of the other two. In *Raia radiata* the electric cup is little more than a muscular fibre with one end expanded, the expanded end being slightly excavated to support a greatly enlarged motor plate, in which terminate numerous nerve fibres. It thus only remotely resembles the well-formed electric cups of *Raia circularis*. The median striated layer of the other two species is absent in *Raia radiata*, and the electric layer is indistinct.

The second part of the paper deals with the development of the electric cups of *Raia radiata*. It is shown that the rate of development compared with the other two species is extremely slow, the organ being scarcely completed when the skate has reached its full size.

The comparison, therefore, tends to show that the organ of *Raia radiata* is in the process of development.

"The Minimum Point of Change of Potential of a Voltaic Couple." By Dr. G. Gore, F.R.S.

In this communication is described the following very simple method of detecting the influence of the minimum proportion of chlorine or other soluble substance, etc., upon the electro-motive force of a voltaic couple (*Nature*, vol. 38, p. 17).

Take a voltaic couple, composed of an unamalgamated strip of zinc or magnesium (the latter is usually the most sensitive), and a small sheet of platinum, immersed in distilled water; balance its electric potential through an ordinary galvanometer of about 100 ohms resistance by that of a precisely similar couple, composed of portions of the same specimens of the same metals immersed the same moment as the other pair in a separate quantity of the same water, and gradually add to one of the two cells sufficiently small and known quantities of an adequately weak solution of known strength in a portion of the same water of the substance to be used, until the balance is upset, and take note of the proportions of the substance and of the water then contained in that cell. In the present experiments a magnesium-platinum couple was employed.

The minimum proportions required with several substances were as follows:—Potassic chloride between 1 part in 3,875 and 4,650 parts of water; potassic chlorate between 1 in 4,650 and 5,166; hydrochloric acid, between 1 in 516,666 and 664,285; and with chlorine, between 1 in 15,656,500,000 and 19,565,210,000.

The proportion required of each different substance is dependent upon very simple conditions, viz., unchanged composition of the voltaic couple, a uniform temperature, and employing the same galvanometer. The apparently constant numbers thus obtained may probably be used

as tests of the purity or of the uniformity of composition of dissolved substances.

The "minimum point" varies with:—1st, the chemical composition of the liquid; 2nd, the kind of positive metal; 3rd, to a less degree with the kind of negative metal; 4th, the temperature at the surface of the positive metal and at that of the negative one; and, 5th, with the kind of galvanometer employed.

The order of the degree of sensitiveness is manifestly related to that of the degree of free chemical energy of the liquid, also to the atomic and molecular weights of the dissolved substances, and to the ordinary chemical groups of halogens. The greater the degree of free chemical energy of the dissolved substance, and the greater its action upon the positive metal, the smaller the proportion of it required to change the potential.

As the "minimum point" of a chemically active substance dissolved in water is usually much altered by adding almost any soluble substance to the mixture, measurements of that point in a number of liquids at a given temperature with the same voltaic pair and galvanometer will probably throw some light upon the degree of chemical freedom of substances dissolved in water.

EDINBURGH BOTANICAL SOCIETY.

At the monthly meeting held on the 13th inst., Dr. Craig presiding, an obituary notice of the late Professor De Bary was contributed by Professor Bayley-Balfour, who spoke of the abundance and extraordinary richness of De Bary's botanical work, and his great services to biology, mentioning specially his work on the comparative morphology and biology of the fungi. Mr. R. Lindsay read a paper on dimorphism in the leaves of New Zealand veronicas, pointing out some remarkable instances that had come under his observation. The Secretary read a paper by Mr. W. E. Fothergill on the leaves of climbing plants; and Mr. P. Sewell made a contribution on similar modifications in the characters of different plants. The report of Mr. R. Lindsay, curator, on the progress of open-air vegetation at the Royal Botanic Garden stated that the month of May had been in general dry and cold, with easterly wind. The thermometer was six times at or below the freezing-point, indicating collectively 5 degrees of frost, as against 12 degrees in the corresponding month last year. The foliage of most of the ordinary forest and ornamental trees and shrubs came rapidly forward, and notwithstanding the backward kind of weather experienced, fine luxuriant leaves had been developed. Those which had already flowered—such as horse-chestnut, lilac, azaleas of all sorts, magnolias, and the various species of pyrus and prunus—were considerably above the average in this respect. The profuse manner in which the many varieties of holly had flowered was very remarkable. Herbaceous plants were generally late in flowering, but promised to be finer later on. The rock-garden was very attractive during the month, from the large number of plants in blossom. During May, 367 species and varieties came into flower, while a large proportion of those which began to flower during the previous month were still in good condition.

Pheasants' Nest in a Fir Tree.—Mr. Digby Owen, writing in the *Field*, mentions that a hen pheasant was found sitting on her eggs in the deserted nest of a wood pigeon, at the height of 50 feet from the ground.

THE SOCIAL CONDITION OF THE BABYLONIANS.

Abstract of a Course of Lectures delivered by Mr. G. Bertin, M.R.A.S., at the British Museum. Second Lecture—Social Organisation.

Babylonian monarchy was what may be called a limited despotism, for the king, though having full power over the life and property of his subjects, had to take into account the established laws, the recognised rights of the citizens, and, to an extent greater than is generally thought, the opinion of the priests, the scribes, the administrators of the laws, and lastly of the mass of the people. For instance, the capture of Babylon, by Cyrus's general, who entered it without fighting, was due to the general dissatisfaction on account of the king, Nabonidus, having neglected his duties. There was no aristocracy, in our modern sense of the word; the two principal races, Akkadian and Semitic, had been so well amalgamated that they formed an united nation, and Akkadians and Semites were on an equal footing before the laws. If the king occasionally granted certain privileges to private persons, it was only for special services rendered to the State; and as these privileges were not hereditary, an aristocracy was never created.

From the point of view of wealth and influence, the Babylonian society may, however, be divided into four classes. These classes did not form castes as in India, and a man successful in life could pass from one class to another; we have even examples of people of the lowest rank of society rising by their own capacities to the highest post in the State. The first class of this division comprised the members of the royal family, the governors of provinces and towns, the high civil and military officers, the magistrates, the large land owners and the great merchants. The members of this higher class had no idle life, as happens frequently in modern Europe: all the civil officers had to render an exact account of their conduct, and by numerous reports keep the king or the central power well acquainted with everything going on in the provinces or in Babylon itself. The magistrates had to sit every day in their tribunal to read the statements brought to them, hear the witnesses, and give their judgments. The large land owners, and the great merchants did not despise their calling, but both superintended their respective occupations, the former visiting their farmers and entering into direct contracts with them, the latter carrying on an active correspondence with their agents abroad, as well as attending to their business at home.

The priests and the scribes might be included in this higher class, on account of the great influence they exercised, but this influence was entirely moral: the priests had to perform the religious ceremonies considered indispensable to the safety of the State; the scribes were the depositors of all the knowledge and science of the past, and to them the king had often to refer.

The civil officers of lower grade, and the smaller land owners formed the second class, in which were also included: the merchants of smaller fortune; the bankers, who generally were also money lenders; the slave owners, making a profession of letting out the the slaves and dealing in them; the artists, poets, and architects, forming a class which must have been numerous, judging from the remains found in Babylonia; and lastly, the magicians, who used to answer to our medical men or the medicine men of the Red Indians. The magicians

formed a distinct class from the priests; the latter had only ceremonies to perform and omens to take; they also received the offerings of the supplicants, and even performed certain rites for them, while the magicians attended the sick, and by their incantations, and sometimes by the administration of potions, endeavoured to bring them to health again. In some cases the magicians were guilty of witchcraft, bringing by their incantations curses or diseases on the head of their client's enemy. They had brought this science to a very high degree of perfection: there were incantations to bring, as well as to remove, every kind of illness, and also to remove curses and hatred, or bring on sympathy and love.

The third class was composed of the small agriculturists, shopkeepers, artisans, working men, and journeymen of every kind. This last class was rather numerous, and though the manual work was generally done by slaves, the skilled artisans were not infrequently freemen.

The fourth class has fortunately ceased to exist in Europe; I mean that composed of serfs, who were considered as part of the landed property. The slaves who also belonged to this class were on many accounts in a better position, as the laws and customs provided for their protection.

The organisation of the family—family with the extended meaning of the Latin *familia*—is in a great measure the image of the social organisation of a nation, and for this reason a subject of great interest to the student. In Babylon the paternal authority was not more limited than that of the king. The father had great powers: he could, for instance, sell his children as slaves, but he had also duties, the neglect of which was punished by the laws. An old text-book, dating back from the earliest period of the Babylonian monarchy, gives us special information on the subject. It says that when the child is born the father must receive him, and by this act recognises him as his own child; when the child has grown he must teach him how to read the inscriptions, and provide food and clothing for him. The father is also ordered to provide a wife for his son and a husband for his daughter. There were also other customs, which appear to have fallen in disuse in course of time, as for instance the consecration to the temple of the firstborn son, a custom which, however, was preserved among the Jews.

The duties of man, as a husband, are also well defined by this ancient code. There were two kinds of marriages—by contract and by purchase. The first kind was general amongst the daughters of the higher and middle classes. The wife in this case brought to her husband a dowry, money, landed property and slaves, house, furniture, etc. She always retained exclusive power over her dowry, which, when there was no issue, returned after her death to her own family. No man could have more than one wife of this kind, and could not repudiate or divorce her without taking legal proceedings. The law is careful to state that such a wife must be a free-born maiden. The other kind of wives were not much better than slaves: the husband bought them from their parents, and could have as many as his fortune allowed; it is this kind of wife which is designated often in the Bible by the name of handmaid. The husband had absolute power over his bought wives: he could repudiate them at pleasure, and if one was guilty of unfaithfulness could demand her death.

The position of women among the Babylonians has been much exaggerated. They had no political right; they were dependent upon their parents or husbands. They had, however, the right of seizin: they could hold houses, fields, leases, etc. In contracts the right of some female relatives over properties sold are often mentioned. They could trade in slaves, houses, and other commodities, and their husbands had no claim over their private possessions. Tablets mention instances of women carrying on an extensive trade, and having their own husband as an employé. This privilege of women seems to have slowly developed through the system of settlement: the dowry was first made special property of the wife beyond the reach of the husband; then property settled on her was afterwards assimilated to the dowry; and, lastly, all properties which she should acquire. Besides that, a wife had always claim on her husband for the necessities of life.

The submission of the children to their parents was their first duty. It is only at the age of twelve that they became answerable for their actions, but even after this age they remained under their parents' power, especially for the most important step of life—marriage—the consent of the parents was indispensable. The law was very severe against disobedient or disrespectful children. When the father or mother was in poor circumstances, the children were obliged to provide for them; if they refused—or, as it is put in the Babylonian code, if they denied their parents—they were sold as slaves or outlawed.

In the term family, slaves must be included; the laws and customs of Babylonia protected them to a great extent. There were several classes of slaves: the lowest or common slaves were those acquired by purchase in public markets. The slave markets were provided from the war prisoners or captives after foreign conquest; these slaves did not rank much above horses or dogs, and their master had absolute power over them. It was not so for the slaves born in the house: these had privileges; their masters were obliged to provide them with the necessities of life, and if they were sold, the purchaser undertook to treat them as their old master would have done. Some slaves were even admitted to posts of trust. In contracts we often see the *galla*, or chief slave, acting for his master, and even signing the documents. Slaves could be freed, but, as in Rome, though considered as free men, they were always under certain obligations, and, if they misconducted themselves, they returned to servitude. The child of a freed slave was, however, completely free. To these kind of privileges enjoyed by the slaves may be due perhaps the fact that in the history of Babylon there is not an example of a slave rising.

The part played by Atmospheric Nitrogen in Vegetation.—Professor Chevreul (*Comptes Rendus*) insists that the absorption of gaseous nitrogen by plants is no novel discovery, but that as far back as 1854 it was recognised by a special Commission of the Academy, including MM. Dumas, Regnault, Decaisne, Peligot, and Chevreul. The recent researches of MM. Gautier and Drouin have simply confirmed the conclusions of M. Georges Ville, as verified by the above Commission.

Sulphur Springs in Paris.—Sulphurous springs have been discovered in digging foundations in the Isle St. Louis, the most ancient part of Paris. The soil contains gypsum and also organic remains.

THE EFFECT OF OIL ON WAVES.

IT is now somewhat over a century since Franklin made his experiments on the effect of oil on the pond at Clapham. His attention had been drawn to the subject by noticing the smoothness of the sea around some ships from which a quantity of greasy water had been thrown, and in his experiments he found that a teaspoonful of oil poured on the windward side of the pond gave its previously ruffled surface a mirrorlike smoothness. But Franklin's observations were overlooked until attention was called to the subject a few years ago by articles and correspondence in *Chambers's Journal*. Since then the subject has met with increasing attention, and has been the occasion of reports from the Royal National Lifeboat Institution, the U. S. Hydrographical Office, and the English Admiralty, as well as of a recent French work by Vice-Admiral Cloué.

When a drop of oil is placed upon a clean water surface it spreads with great rapidity over a very large area, forming a continuous film of extreme tenuity. A simple experiment, which can be made by any one, will illustrate this. Take a soup plate, which has been very carefully cleaned and freed from grease by means of soda. Fill the plate with clean water from the tap, and place the plate in front of the window or a gas lamp, so that the light may be reflected from its surface. A few specks of dust will generally be seen floating on the water; watch one of these whilst a pencil or bit of stick, which has previously been dipped into oil, is made to touch lightly the surface of the water at its centre. The moment the pencil touches the water the speck of dust will be seen to fly off with great rapidity towards the rim of the plate, being driven by the spreading film of oil which has covered the whole surface of the water. If now the pencil be again brought into contact with the water so as to deposit a small drop of oil upon its surface, this drop of oil will spread with comparative slowness, showing as it does so the brilliant iridescent colours due to the interference of light reflected from its two surfaces, which, however, soon again disappear as the film extends and becomes thinner. The thickness of the oil film first formed is, in fact, far less than a wave length of light (which itself lies between fifteen and thirty millionths of an inch), being probably not more than a fiftieth of this, or less than a two-millionth of an inch. A single grain of oil would therefore cover an area of fifty or sixty square feet or more.

By the presence of such a film the phenomena depending upon the surface action of the water become materially changed, and it need, therefore, cause no surprise that so small a quantity of oil should so greatly affect the production and maintenance of those water-waves, whose origin lies in the interaction of the air and the water. When the wind blows over the sea with sufficient force the friction between the wind and the water causes the latter to be thrown into ripples, whose propagation depends almost entirely on the surface tension of the liquid, but with increased velocity of the wind these ripples give place to true waves, whose propagation depends on the gravitating forces of the water, and whose velocity of motion depends on the height and breadth of the waves and the depth of the water.

In ordinary water-waves, such as are produced by moving the hand up and down on the surface of still water, the commotion travels outwards with a certain speed as an undulatory motion, in which the individual particles of the water only execute oscillations about their positions of rest, so that a cork floating on the surface of the water simply moves up and down as the waves pass it. Of a similar nature are the ordinary unbroken waves seen on the surface of a bay during fair weather. But when such a wave approaches the shore and reaches the shelving beach, its character changes. The impediment offered to the motion of the wave by the friction with the ground beneath becomes perceptible at some distance from the shore, and increases as the wave advances into shallower water, with the result that the form of the wave becomes more and more steep towards the shore, until at last it curls forward, and the upper part of the wave acquiring an onward motion, it rushes up and breaks upon the beach. The change, which in this way takes place in the character of the wave from a simple symmetrical undulation to a bodily onrush of the water, which is here caused by the retardation of the lower portions of the wave, may also result from an acceleration of the upper part of the wave by the continued action of the wind. When a wave after its formation is further acted upon by the wind, the the effect is twofold; firstly, to increase the size of the wave, and secondly, to change its form. The wind blowing horizontally over the water exerts more action on the crest of the wave than in the trough between, and thus causes the wave to become more and more steep on the leeward side, until at last its crest topples over and breaks. It is thus that the "catspaws" are produced when the sea is agitated by a rising wind, or the gusts which precede a squall; and in a larger but similar way the comparatively harmless rolling ocean waves become changed during a storm into the destructive walls of water which break with such terrific force upon the decks of a ship.

The trials which have been now made of the effect of oil show quite clearly that not only can the thin film of oil, interposed between the wind and the water, check the formation of waves in comparatively still water, but also, and in this lies its great utility, it can prevent the formation of the great walls of water just mentioned, the waves as they enter the oil-covered area passing along as great swells upon which the ship rides in comparative safety. In this way even small boats have been enabled to ride out for nearly three days a violent cyclone, while moored to a raft of broken spars and rigging to which bags of oil were fastened.

For oil to be effective during a storm, it must be applied so as to form an oil protected region extending from the ship in the direction from which the waves advance. This can be effected by letting the ship ride at anchor with canvas bags, each containing a few pints of oil, preferably of animal or vegetable origin, slung from the anchor chain or a forward part of the ship; or if the ship be let drift before the wind, it is sufficient to let the bags hang over the side, as the drifting of the vessel by the wind will carry it into the protected area. A very small quantity of oil suffices, five or six gallons being ample for twenty-four hours, and it should be allowed to trickle slowly from pricks in the bags, as a more rapid flow only causes waste.

In those cases where the breaking of the waves is due not to the wind but to reefs or other obstacles below the surface of the water, the action of oil is not so marked, though even here it does some good. In the report of the National Lifeboat Institution, while the benefit of oil to ships in the open sea is acknowledged, it is concluded

that the cases in which oil would be of service to lifeboats are not of such frequent occurrence as to justify the recommendation that an oil tank should form part of the necessary equipment of a lifeboat. In the pamphlet of the U. S. Hydrographical Office we find the same testimony, that the best results are found in deep water, although some benefit may be expected in surf or breakers.

On the whole the utility of oil in calming water has been satisfactorily settled, and as the ease of its application is so great and the cost so small, there can be no excuse for a vessel to go unprovided with the requisite small supply.

ASTRONOMICAL IDEAS OF THE NEGROES OF CENTRAL AFRICA.

FATHER VYNCKE, a missionary from Algeria, gives, in a letter written from Kibanza, and reproduced in the *Revue des Questions Scientifiques*, and in *Ciel et Terre*, some details as to the astronomical knowledge of the tribes on the western shore of Lake Tanganyika. Though the sun is vertical in their country twice yearly, they care little for his movements, and have no notion of a solar year, but the moon plays a great part in their life. The appearance of the new moon is greeted with the beating of drums, the discharge of guns, shouts of joy, and general dances. To know the age of the moon they keep twenty-eight or thirty little rods in a box and take one away every day. All this agrees with the view of Mr. Gerald Massey that in early ages moon-worship must have preceded sun-worship, and that the attempt to resolve primeval traditions into the "solar myth" is delusive.

To determine the seasons and to know the time for agricultural operations, fishing, etc., they consult the stars. The rising of the Pleiades shows seed-time, and is celebrated with dances and festivals in honour of the dead. They call this constellation *Kili*, that is, "seed-time." The Milky Way is called *Louvouma ne nzamo ne bouzovo*, the boundary between drought and rain, for when it appears in the east at sunset, the rainy season sets in. The rising of the belt of Orion, *Lousiwe*, shows the time for fishing for the *Nouzi*. Aldebaran is with them *Kalama cha mounza*, the diamond of the north; Sirius is *Kalama cha kiama*, the diamond of the south. The Centaur, the Southern Cross, and Argo, including the splendid star Canopus, invisible in Europe, are called *Mazira* and *Mironzo*, that is, the "paths" and the "tens," because they show the way to the south pole, and are composed of a great number of stars.

THE FUTURE OF SAILING VESSELS.—*Cosmos* suggests that sailing vessels, as opposed to steamers, may regain something of their old importance by storing up the superfluous energy of the wind in accumulators, and employing it in case of calms or contrary winds. The accumulators may serve as ballast.

PLAGUE OF CATERPILLERS.—The oak-trees over a great part of Epping Forest are almost entirely stripped of their leaves by a prodigious swarm of small lepidopterous larvæ, evidently belonging to two or three species. Limes, fruit trees, and rose-bushes are also being very severely attacked. This fact shows that a hard winter, contrary to the popular belief, has very little effect in ridding the country of vermin.

MESMERISM.

(Continued from p. 597.)

A CERTAIN method employed for producing the hypnotic condition drew at one time much attention. Whether it is still employed we do not learn, but it has bequeathed to the world a very misleading word. A disc of copper and zinc was laid in the hand of the subject, and he was told to gaze fixedly upon it for some time. By this means certain susceptible persons were thrown into the hypnotic state, the result being attributed by persons as ignorant of physiology as of electricity to the galvanic current supposed to be set up by the disc and passing into the nervous system of the patient. Hence this process was called—"in contempt of Greek and of science," as the late G. H. Lewes put it—electrobiology. Soon, however, it was found out that a disc of a single metal, or of wood or horn acted just in the same manner. Hence the first part of the term was dropped, and the operation became known in certain circles as "biology." This horrible misuse of language, in spite of rigorous protests, has not yet been abandoned.

It has been observed that in susceptible persons the surface of the body often presents certain special points named "hypnogenic zones." Pressure upon these brings on the hypnotic state.

Professor Charcot divides the hypnotic phenomena into three distinct kinds, to which he gives the names *catalepsy*, *lethargy*, and *somnambulism*. These three states do not succeed each other in any fixed order, but if a person is repeatedly hypnotised catalepsy is generally first produced. In this state the patient seems indifferent to all objects around him. The pulse becomes slower and the respiration feebler. The limbs remain in whatever position they are placed by the operator. The skin loses all sensibility, so that the prick of a needle or the contact of a glowing cinder is not felt. The prolongation of this state is unsafe, as it involves great exhaustion.

In lethargy the patient is perfectly helpless—unable even to stand. His condition is very similar to that known as ecma—a state which may be brought on by certain diseases or by the action of narcotic drugs.

It must be remembered that both in catalepsy and in lethargy the subject is completely at the disposal of the operator, and has no will of his own remaining.

The third state is a kind of transformation of either of the two former. When they are established somnambulism may be produced by gentle friction applied to the crown of the head. The patient then returns, not indeed to full self-possession, but, at any rate, to a consciousness of the outer world. The senses, instead of being in abeyance, are intensified. In almost every case the patient is "suggestible," that is, his brain lends itself at once to the commands or the suggestions of the operator. This phenomenon is both scientifically and practically of such importance that it demands, and has received, very close study. We often meet with persons who have little will of their own, and who readily adopt the opinions and follow the lead of others. We meet also with others who have a remarkable power of controlling the opinions and the actions of a majority of those around them. To this latter class belong all the great mischief-makers of the world. Now, the relation between the hypnotic operator and his patients is merely an intensification of that which exists between the political agitator and his followers, or between the founder of a sect and his disciples.

The somnambulist not only believes, but even sees' hears, tastes and smells what the hypnotiser commands. If presented with lamp of tallow and told it is a peach he will eat it with relish. If told that he is cold he will shiver on the hottest day in summer. If assured that he is in utter darkness the pupils of his eyes will be widely expanded though a lamp be held at a few inches from his face. If told that a piece of blank paper is a photograph of the operator, he recognises the likeness and will pick it out from a number of other papers. Furthermore the patient acquires, for the time being, an abnormal acuteness of sight and hearing, and in like manner of the other senses. He can see sights and hear sounds which in his ordinary condition he would fail to recognise, owing to their distance. It is even believed that the somnambulist can read papers placed among the leaves of a book, or locked up in tightly fitting boxes, see what is taking place in distant towns, recognise objects placed behind his head, etc. But on these points the evidence is by no means complete, and it is therefore prudent, at any rate, to suspend judgment.

We must further note that the subject will perform, or endeavour to perform actions, good or evil, suggested by the operator. But in so doing he does not act automatically, but uses, in the execution of the act suggested, the resources of his own mind. There is, however, as yet no instance of a crime having been committed by a somnambulist subject acting under orders from the operator. It is even said that the suggestions instilled into the mind of the patient are persistent, and may be carried out after a fixed time. No record, however, exists of crimes of this kind actually committed. It is of course open to believe that the strange hallucinations, the "inward voices" which urge a weak-minded person on to some evil deed, may have here their origin.

One crime, however, may be fairly charged against hypnotism, but that is committed by the operator upon the subject.

"Suggestion" does not exclusively belong to the true somnambulic state; it is probably not absent in the lethargic condition. It is even certain that suggestion can be conveyed in catalepsy, though this question has been but little studied. Some cataleptic subjects differ in this respect but little from somnambulists. They are slower in manifesting emotions and accept suggestions less readily, but if such suggestions are once accepted they are carried out more automatically and more inevitably. In this state special suggestions of a very interesting character. Thus there are suggestions by gesture. If the patient is placed in the attitude naturally adopted by persons under any particular condition or set of circumstances the whole frame conforms to the supposed situation. Thus if the arm of a motionless cataleptic is raised so as to bring the fingers in front of the mouth, as if wafting a kiss the countenance at once assumes a peculiar smile and the body is inclined forwards. If the arms of the passive patient are then placed in the position taken by pugilists, the face and the whole body accommodate themselves to this situation also.

Dr. Ducherme, of Boulogne, as it is widely known, has determined by local faradisation the functions of the several muscles of the face which express feelings. Now if such a muscle or group of muscles is excited electrically the process is reversed; instead of the feeling producing the expression of the face, the expression calls up the feeling. Thus let the pyramidal muscle of the nose, which Ducherme names the *muscle of aggression*, be excited electrically in a cataleptic subject, at once the muscle contracts and the skin of the base of the nose is wrinkled transversely. This is a local effect of the electric action. But whether it be from habit or from an inherited association of certain cerebral functions with the action of the muscles which they govern, the patient experimented upon at once takes a special attitude corresponding to the facial expression and similar to that prompted by aggressive feelings. The fists are clenched, the body is inclined forwards, and the entire posture is that of a man about to attack an enemy. By a very complex operation the excitement of a single special muscle is thus found to suggest a special correlated thought, the thought of attack or defence, and the brain completes the series of acts. In this instance the thought of fighting arises, and is worked out in a reverse order to that which naturally occurs.

Hypnotism, or whatever name we may prefer to give to the totality of phenomena in question, is thus seen to be of great value in studying both certain difficult problems of physiology and the still more complex mechanism—if we may use the expression—of thought.

As a curative agent—when, and only when it is employed by competent and experienced medical men—hypnotism is eminently valuable. For more than ten years it has been observed at the Hospital of La Salpétrière that in hysterical patients hypnotisation, often repeated and systematically managed, greatly diminishes the frequency of the attacks. It is further found better to throw the patient into the hypnotic state rather than to allow an attack to come on. But this must be done in good time, for if once the paroxysm has come on, the patient is no longer susceptible of hypnotisation. When the hysteric patient is awakened after a certain time, she will have escaped the convulsions.

It is further well known that after an hysteric seizure has passed away, there sometimes remain certain complications that may terminate in permanent contraction or paralysis. But, leaving these considerations as too purely medical for our columns, we must urge that hypnotism is no plaything, but must be employed only with the most scrupulous care. More than forty years ago James Esdaile said, "Public opinion will suppress all those who practice hypnotism for any other purpose than medical utility or scientific research." To bring it forward as a public entertainment, about on a level with ventriloquism or legerdemain, is nothing short of a crime. There have been, and doubtless still are, mountebanks who, knowing nothing of medical science, and employing the most violent methods, go about magnetising persons who are either reckless or ignorant of the dangers which they run. Some of those who attend such lectures begin to practise hypnotic manipulations at home on those around them, and thus create foci of mischief—physical, moral, and intellectual. It need scarcely be said that these cautions apply with double force when the subject—we might say the victim—is of the female sex. Instances without number might be given to prove the mischief wrought by these hypnotisers, be they amateurs or charlatans. Even the "willing game" which was fashionable not long ago, has given rise to serious mischief.

It is, therefore, sad to see any person adventuring his willingness to instruct applicants how to become public demonstrators of animal magnetism. By what name the operations are called is here a perfectly idle question, nor does it matter whether hypnotism, mesmerism,

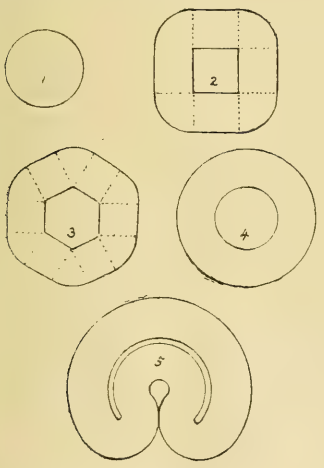
animal magnetism, electrobiology, statuvolism and the like are strictly identical or not. All are dangerous if indiscreetly or malevolently used. Very lately the Italian Government, acting under the advice of Professors Combroso and Tommasi, interdicted the exhibitions which were being given by one Donato, a "magnetiser," who had made upwards of forty persons ill in Milan and in Turin. The governments of Austria and Germany had some time previously forbidden one Hansen to ply this dangerous calling within their borders. In our "free" country the quack, of all types, has free course and is glorified, the law of libel being his sword and shield. But without fear of legal proceedings we may at least warn every person not to allow himself—or still more herself—to be "magnetised," save under competent medical advice.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

A CIRCLE PROBLEM.

I regret that several slips appear in the letter on p. 549, under this title, but whether they are due to the printer, or to my own carelessness, or to the wilful obstinacy of my type-writer I cannot tell. It is well known that most type-writers spell abominably, but mine occasionally makes statements which astonish me The length of the circumference



in feet should be 71,286, and this may be taken as the distance travelled by the inner handle (not the diameter, as a transposition of sentences suggests). On a practically flat surface the difference in length of the circumferences will be as I have stated, but we cannot get a flat surface on the earth if we take circles of several thousand miles in diameter, and when the surface ceases to be flat, this solution of the problem ceases to be true. The diameter of the earth in round figures is 8,000 miles, or, as Whittaker's Almanack gives, 7·896, or, for those who don't like round figures, Chambers' table give 20,923,600 ft. as the equatorial diameter. Another 26 miles would give a circumference of almost exactly 25,000 miles.

Having corrected the blunders, allow me to give an explanation of the apparent paradox. Fig. 1 represents a circle 18 ft. in diameter, the circumference will be about 56·54 ft. The track of the inner handle in this case would be zero, the outer handle simply revolving round it. In fig. 2 the track of the outer circle is made up of four straight parts, and of four quarters of a circle, the radius being as before, 9 ft. It is evident that the outer handle does not travel farther than the inner while on the straight portion, but on the curves it travels farther by a distance equal to the circumference of the circle in fig. 1, viz., 56·54 ft. Again, in fig. 3, where there are 6-6ths of a circle, by the same reasoning the difference in the lengths of the outer and of the inner track will still be 56·54 ft. Now the inner circle of fig. 4 may be considered as a polygon of an indefinitely great number of sides, and the outer circle, as consisting of indefinitely short straight parts and curved parts, the difference will still be the same. If the track is in the shape of fig. 5, or any other irregular figure, the difference will still be the same. A. P. T.

THUNDERSTORMS AND LIGHTNING ACCIDENTS.

As the season of thunderstorms and lightning accidents is now approaching, I hope you will kindly allow me to make known through your columns the fact that, in the interest of science, the Institute of Medical Electricity is very desirous of obtaining authentic information concerning lightning accidents, whether fatal or otherwise. I should therefore esteem it a favour if some of the many friends of humanity among your readers will assist us to investigate these phenomena by sending me such particulars of accidents of this nature as they may have personal or reliable knowledge of as soon after they occur as possible. Of course, electrical and physiological details are what we most require, but reliable general information is often very valuable, and will be gratefully received."—H. Newman Lawrence, A.S.T.E. and E, 24, Regent Street.

"A PLEA FOR THE SPARROWS."

A paragraph in the Scientific News (p. 568) ascribes the plague of insects in Kent to the "scarcity in sparrows." Now, without entering upon the very questionable character of the sparrow as a vermin-destroyer, I must beg to point out, in reply, that the plague of caterpillars and grubs is severely felt in parts where there has assuredly been the destruction of sparrows, to wit, Epping Forest and its surroundings. It is perfectly possible that the methods taken for thinning the sparrows have destroyed or banished the useful birds. Sigma.

The Value of Scientific Education.—We find in a contemporary an advertisement for a "chemical assistant to science master in public school, *able also to teach swimming*." What remuneration will be offered for this double qualification we are unable to say, but we fear the sum will be very trifling.

Congress of the French Association for the Advancement of Science.—This congress has hitherto received very little notice in the scientific press. *Le Temps* of April 21st devotes more than a column to the account of an excursion made on April 3rd to some Arab villages near Oran, but of the papers read we find nothing. How is this?

Effects of Severe Weather. — The experience of the past seven months goes far to show that cold weather has exceedingly little efficacy in checking epidemics. The old faith in its power of destroying insects has long been found to be baseless, since the ova of many of the most noxious species bear a temperature of 22° F. below zero without injury.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

STAKE.—Mr. Kemp, of Streatham Common has patented a "Stake for supporting and watering plants." It consists of a tube which has its lower end sloped off, and is near that end perforated with holes. The upper mouth of this tube is funnel shaped, and a flanged plug is inserted in the mouth of the tube to receive the blows necessary to drive the stake into the ground. The plant to be supported is tied as usual to the stake. For watering the plant the plug, is taken out of the tube, and the water poured down it, which will then find its way out through the perforations into the soil close to the roots of the plant.

ELECTRIC MEASUREMENT.—An instrument for electric measurement has been patented by Messrs. W. Emmott and J. H. Rider, Halifax. This invention consists of a soft iron needle free to move in a magnetic field, and made of such form that varying quantities of iron are brought into the field as the strength of it is varied. Any variation of the strength of the field causes the needle to rotate on its axis without altering its distance as a whole from the magnetic poles. This is accomplished by making the outer edge of the needle of a circular form while the thickness varies; the rotary movement of the needle is counteracted by gravity.

FUZE.—Messrs. J. H. Burke and A. Leather have patented a centrifugal percussion fuze for shells. The invention consists in a shell fuze in which the pellet carrying the detonating cap is prevented from moving forward to strike the needle point by the interposition of guards, which are kept in position by springs under all circumstances except when the fuze is made to spin. A spring arrangement is fitted to the side of the pellet to prevent it from creeping forward during flight, but sufficiently weak to permit the pellet to move against a needle point when the shell has a sudden check. A spring automatic shutter is also fitted to close the hole through which the safety pin passes, on the latter being removed.

UTILISATION OF THE SUN'S HEAT.—Professor Morse of Salem, Massachusetts, has devised an ingenious method of utilising the heat of the sun. He places outside a building, in such a position that the sun shines directly upon it, a shallow box, the bottom of which is of corrugated iron, and the top of glass; the heat rays of the sun pass through the glass, and are absorbed by the iron, heating it to a high temperature, and by a system of ventilation a current of air is passed through the apparatus and into the room to be heated. It is stated that by this means the air has been heated on sunny days to about 90 deg. Fahr.

DYNAMO-ELECTRIC MACHINE.—Mr. J. P. Hall has patented a dynamo-electric machine. To carry out this invention the bed-plate, the standards for carrying the pedestals, and the keeper are cast together in one piece, and each core of the magnet is formed of one piece of wrought iron, the core embracing that portion on which the wire is wound, which is circular in section, and also the upper portion, which is of any form. Holes are bored through the keeper slightly reduced in diameter to form a shoulder, which rests upon the bed, and the cast-iron keeper is made of such section that its resistance is not greater than that of the wrought-iron parts of the circuit. The magnet cores are wound with wire, and then placed in the holes in keeper prepared for them and secured in position by a screw.

CIRCULATING AIR.—Mr. J. H. Dinsmore has patented means for heating, drying, and circulating air. Described in respect to a linen-drying closet. The air used is heated by contact with gas-heated surfaces at the lower portion of the closet. The heated air ascends to the upper part of the closet, and there passes out by a pipe. It is then led round and redelivered into the lower portion, this circulation being rendered automatic by causing the hot air coming from the closet to become partially cooled by exposure of a part of the pipe through which the air is led to the cooler air. In the cooling a quantity of vapour is deposited upon the internal surface of the pipes. The condensed vapour is led away by a trap. The air is cooled to as small an extent as possible, that is, the air is cooled only to such an extent as will cause it to deposit as much vapour as will keep it in a condition that will absorb readily fresh vapour given off from the clothes at each rotation of the air.

LIGHTING RAILWAY CARRIAGES BY ELECTRICITY.—Messrs. J. L. Yuly and H. W. Andrews, of Southsea, Hampshire, have patented a method of lighting railway carriages by electricity. The object of this invention is to provide a means by which the speed of a dynamo worked by the rotation of the carriage axles can be altered to suit the speed at which the train is running, and to automatically switch the storage batteries on and off when the train is running too slowly or quickly. A wide drum is placed on the axle of one pair of wheels, and open and crossed belts passing around it drive three pulleys on a countershaft, the middle pulley being fixed, and the others loose. Expanding pulleys are keyed to the countershaft and to the axle of the dynamo. These pulleys have their bosses, by means of which they are keyed to their shafts, formed into conical driving pulleys, which by means of belts drive similar cones on short shafts parallel to the other shafts. These short shafts have ordinary driving pulleys keyed to them, which by means of belts drive similar sized pulleys on the sleeves carrying the expanding cog wheels. The sleeves carrying the cog wheels run loose on the dynamo shaft and on the countershaft, and are kept in gear with their respective pinions by means of collars. By shifting the belts along the cones, the bevel cog wheels are made to run faster or slower than their respective expanding pulleys, and thus set the pinions in motion and increase the diameter of the expanding pulleys. The belt slipping devices are fitted with springs, so that when the hand-lever is released the belts immediately move to the middle of the cones. Storage batteries supply the current to the lights while the train is stationary, or is travelling too slow to work the dynamo, and switches are connected to a suitable governor, which is attached to the dynamo or countershaft, so as to disconnect the batteries from and connect the dynamo with the lights when the speed of the dynamo reaches the requisite number of revolutions.

TECHNICAL EDUCATION.

AGRICULTURAL EDUCATION.—On the 20th inst. a deputation from the National Association for the Promotion of Technical Education waited upon Lord Cranbrook, at the Privy Council, to place before him resolutions passed by the agricultural section of the National Association on the subject of agricultural instruction. The President of the Council was accompanied by the Duke of Rutland and Sir William Hart-Dyke. Lord Spencer, in introducing the subject, said that the Association thought that the vote of £5,000 should be employed for three purposes—the encouragement of dairy schools, for the middle-class schools, which would give sound, practical, and useful agricultural education, and for the payment of travelling lecturers. Lord Cranbrook, in reply, said the Government were alive to the interest of the agricultural community, and nobody, in fact, who had gone into the history of agriculture during the past few years could help seeing that, unless something were done to alter its position, it would soon be in a state of decadence which would result in absolute ruin. The great question which in England was always raised was—how much the State was to do, and how much was to be done by individuals. In this country we had the remarkable fact that, without State assistance and with our great agricultural societies, we had succeeded in producing a larger amount of cereals per acre than any other country in the world; and we had produced the best breeds of cattle, and got them to the highest state of perfection. Therefore, there was in this country voluntary initiation, which it was better to support than the attempt to initiate anything on the part of the Government; and he quite agreed with them that they should, if possible, help those who helped themselves. With regard to the elementary schools, it was not quite so easy a matter as might be supposed to introduce real agricultural instruction. In the first instance, the children of the elementary schools left them at so early an age that it would almost be impossible to benefit them, unless they could remain to be allowed to practice it; and in almost every part of the country every cottage had a garden attached, in which boys would probably learn much more from their parents than they would in the short time that could be devoted to it at school. At the same time, there could be a good deal done with older boys if they could get them to attend evening classes, and supplement that with the instruction they got at home in the gardens attached to their cottages. He did not understand that these recommendations were meant to be universally applied. That was in accord with the course which Lord Spencer took in 1881, when he was at the head of the Agricultural Department, in making agriculture not a class subject in the schools, but a specific subject to be taken up by those in the more advanced standards. That would be at a time when something more should be done in the mode training. The same point had been raised as to technical education generally, and the subject of the manual training of boys in the use of ordinary tools, and so on. If they looked through almost any school they would find that a great number of boys were not destined for agriculture, and therefore they could not make it universal teaching in the school. With regard to the training of the teachers, there had been some remarks made with respect to the Science and Art Department at South Kensington, and the training of teachers under their care. There had been an increase going on in the number of those who were taking advantage of the teaching of agriculture at South Kensington, and the numbers had risen considerably. In May of last year there were 7,231 papers sent in; and there were 1,628 more papers sent in this year. Besides, no one was entitled to grants unless a certificate was given that either he had been or was to be engaged in agriculture. As to the question of hand-books on agriculture, there might be some difficulty with the publishers, for, after all, it would be taking upon the Government, not only to advertise one person's work, but it would probably depreciate or destroy the work of others. He could not give much hope that the Government would undertake that duty. As to the grant which had been made to the Department over which he presided, it was only partially an agricultural department at present. They had a veterinary department fully manned and ready to do its work; but they had not a general agricultural department, either connected with dairies or arable land, or in any other way. That new department might be a very great business. With regard to the disposal of this £5,000, the Government had long come to a determination to endeavour to assist those schools which were already in operation. With regard to diary schools, they would send out inspectors to those schools which had been brought to their knowledge to see whether they were fit recipients for the money. With regard to the middle-class schools, they also would be visited to see whether the teaching could be developed in order to benefit agriculture. The subject of travelling lecturers would also be considered, and, in fact, the whole of their resolutions would be duly taken into consideration by the Government with the view of benefiting agriculture. The deputation then withdrew.

SLÖJD.—A meeting took place last week at the Earl of Meath's, 83, Lancaster-gate, for the purpose of starting an association to promote the teaching of the Swedish system of technical education known under the name of "Slöjd," and to assist Miss Evelyn Chapman and Miss Nyström to establish classes for training teachers and others in the above art. The Earl of Meath occupied the chair. Miss Evelyn Chapman explained the origin and objects of the Slöjd system, which is now taught in over 800 schools in Norway and Sweden. The Earl of Meath pointed out the necessity for reform in the educational system of the country, and the desirability, in face of an ever-increasing population, of teaching all classes, from the highest to the lowest, how to use their hands as well as their heads, so that each man and woman might be placed in a position of independence and be capable of earning an honest livelihood. It was shown that Slöjd might include metal-work, smith-work, basket-making, painting, fretwork, bookbinding, *papier mâché*, and wood Slöjd, that its results were to implant respect for work in general, even for the coarser forms of manual labour; to develop activity, to foster order, accuracy, cleanliness, and neatness, to encourage attention, industry, and perseverance, to develop the physical powers, and to train the eye and the sense of form. Resolutions proposing that an association should be formed and a committee appointed for the purpose of promoting the establishment of the Slöjd system in this country were passed, and Lord Meath was requested to act as President of the Association, with Miss Chapman and Miss Nyström as joint Secretaries. Miss Nyström announced that she had received a letter from the Chamberlain to His Majesty the King of Sweden and Norway graciously consenting to become patron of the association.

ANNOUNCEMENTS.

FRENCH ACADEMY OF SCIENCES.—M. Millardet has been elected a corresponding member of the Botanical Section, in place of the late M. Boissier.

ROYAL BOTANIC SOCIETY, REGENT'S PARK.—At a meeting of this Society, held on June 23rd, the Duke of Teck, the President, presented a gold medal and purse of 50 guineas to Mr. Ellis, L.R.C.P., of Liverpool, the winner of the Queen's Jubilee Prize, given by the Society for the best essay upon the plants and vegetable products introduced into the United Kingdom for use in the arts and manufactures, and for food, during her Majesty's reign.

FLUIDITY OF THE EARTH'S INTERIOR.—M. Maurice Levy (*Comptes Rendus*) communicates the result of his researches on the figure of the globe. He gives a formula with four variables, which expresses the reality as closely as possible. From this formula it follows that we cannot bring the law of the variation of densities into harmony with the precession of the equinoxes without supposing the interior of the earth fluid.

DIARY FOR NEXT WEEK.

Monday, July 2.—Royal Institution, at 5 p.m.—*General Monthly Meeting.*

Tuesday, July 3.—

Wednesday, July 4.—Entomological Society, at 7 p.m. Camera Club.—*Excursion to Otford, Kent.*

Thursday, July 5.—Camera Club.—*Meeting to Compare Results Obtained at the Erith and Belvedere Excursion.*

Friday, July 6.—Royal United Service Institution, at 3 p.m.—*The Machinery of Modern War Ships;* by Mr. H. J. Oram.
Geologists' Association, at 8 p.m.—*On the Rhætics and Lias of Glamorganshire;* by Mr. H. B. Woodward, F.G.S. *On the Geology of the Forest of Dean;* by Mr. E. Wethered, F.G.S., F.C.S. *On the Clays of Bedfordshire;* by Mr. A. C. G. Cameron.

Saturday, July 7.—Geological Association. — *Excursion to Lewisham.*

SALES.

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SELECTED BOOKS.

Journal of the Royal Agricultural Society of England, Vol. xxiv., Part I. Permanent Wheat and Barley Experiments at Woburn, by Sir J. Lawes—Indian Wheat Trade, by W. E. Bear—Practical Value of Dung, by R. Vallentine—Laying Down Land to Grass, by J. A. Caird—Wool and its Uses, by J. W. Turner—Cider and Perry Making, by D. R. Chapman, etc. London: J. Murray. Price 6s.

Physical Geology and Geography of Great Britain. By Sir Andrew C. Ramsay, LL.D., F.R.S., etc., late Director-General of the Geological Survey. Fifth edition. Considerably enlarged, and illustrated with numerous sections, and a geological map of Great Britain, printed in colours. London: E. Stanford. Price 15s.

The Coleoptera of the British Islands, Part XVI. By the Rev. Canon Fowler, M.A., F.L.S. Vol. I. 14s. Large paper, with 36 coloured plates, 48s. Vol. II. 18s. London: L. Reeve and Co. Price 5s.

Electricity and Magnetism (a Treatise on). (Methods of Measurement and Applications). By E. Mascart, Professor in the College de France, and J. Joubert, Professor in the College Rollin. Translated by E. Atkinson, Ph.D., F.C.S., late Professor of Experimental Science in the Staff College. London: Thos. De La Rue and Co. Price 21s.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, June 18th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	46·8 degs., being 1·5 degs. below average.	5·7 ins., being 0·7 ins. above average.	414 hrs., being 4 hrs. above average.
England, N.E.	48·1 ,, ,, 1·9 ,, ,, ,,	4·0 ,, ,, 0·6 ,, below ,,	341 ,, ,, 47 ,, below ,,
England, East	50·1 ,, ,, 2·2 ,, ,, ,,	3·0 ,, ,, 1·3 ,, ,, ,,	381 ,, ,, 74 ,, ,, ,,
Midlands ...	50·0 ,, ,, 2·0 ,, ,, ,,	4·0 ,, ,, 0·7 ,, ,, ,,	356 ,, ,, 46 ,, ,, ,,
England, South	50 6 ,, ,, 2·2 ,, ,, ,,	3·9 ,, ,, 0·3 ,, ,, ,,	384 ,, ,, 41 ,, ,, ,,
Scotland, West	48·3 ,, ,, 1·4 ,, ,, ,,	10·0 ,, ,, 3·3 ,, above ,,	382 ,, ,, 34 ,, ,, ,,
England, N.W.	49·2 ,, ,, 2·4 ,, ,, ,,	3·9 ,, ,, 0·8 ,, below ,,	347 ,, ,, 82 ,, ,, ,,
England, S.W.	50·3 ,, ,, 2·4 ,, ,, ,,	5·3 ,, ,, 0·6 ,, ,, ,,	417 ,, ,, 56 ,, ,, ,,
Ireland, North	48·9 ,, ,, 2·1 ,, ,, ,,	7·2 ,, ,, 1·2 ,, above ,,	360 ,, ,, 39 ,, ,, ,,
Ireland, South	51·1 ,, ,, 1·0 ,, ,, ,,	8·4 ,, ,, 2·2 ,, ,, ,,	386 ,, ,, 50 ,, ,, ,,
The Kingdom...	49·3 ,, ,, 1·9 ,, ,, ,,	5·5 ,, ,, 0·3 ,, ,, ,,	378 ,, ,, 46 ,, ,, ,,

The last week of above period was the first this year wherein a temperature below freezing was not observed in any portion of the kingdom; last year freezing temperatures ceased to be observed with the week ending May 30th, and reappeared with the week ending September 19th.

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